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BONE TUMORS*

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THERE is a definite limitation to the findings in a bone lesion depicted by roentgenograms. It is therefore important in trying to increase our ability to interpret bone disease from the roentgenograms to obtain information from other sources in order that we may read such information into the film.

In this paper the subject will be limited to bone tumors, emphasizing their roentgenographic features, and endeavoring to read into the roentgenograms what we have learned or gathered by studying bone lesions from the standpoint of anatomy, embryology and pathology. Emphasis is also laid on treatment, and whether or not radiotherapy is valuable in the particular type of case.

We have divided bone lesions into two groups, those which are primarily related to the bone tissues and their development (i.e., osteogenic tumors) and those which secondarily involve bone either from without by extension or by metastasis, or which are found in the bone because of a relation to vessels or lymphatics (i.e., tumors which are non-osseous in origin).

We begin with tumors of the bone-forming group, or tumors related to osteogenesis.

The first group are the so-called cartilaginous tumors, those arising in early precartilaginous tissue and passing through a developmental stage in which cartilage is a prominent feature. They include four types: the benign osteochondromas or exostoses; the malignant tumors arising in exostoses; the benign central chondromas, and primary chondrosarcoma. The last is a form of osteogenic sarcoma containing cartilage.

OSTEOCHONDROMA

This first tumor (Fig. 1, A and B) is on the humerus in a patient who is an adult. Here the roentgenogram depicts a projection of normal bone, part of which is formed by the deltoid tuberosity of the humerus. In addition to this overgrowth of normal bone, there is a superimposed lobulated mass with definite outline and trabeculae, extending outward into the soft parts.

The other view of the same case shows more typically the lobulated character and the spotty calcification due to cartilage. This case is a benign osteochondroma or exostosis. It is an exaggeration of a normal bony protuberance. It occurs where a tendon attaches directly to bone. Here primitive cartilage is always left in the tendon fibers and this primitive cartilage may proliferate as a tumor. When it does, the bone beneath bulges out to meet it, forming a base or pedicle for the cartilaginous cap. The diagnostic points in this case are: (1) a normal bony protuberance which has been exaggerated into a base or pedicle;

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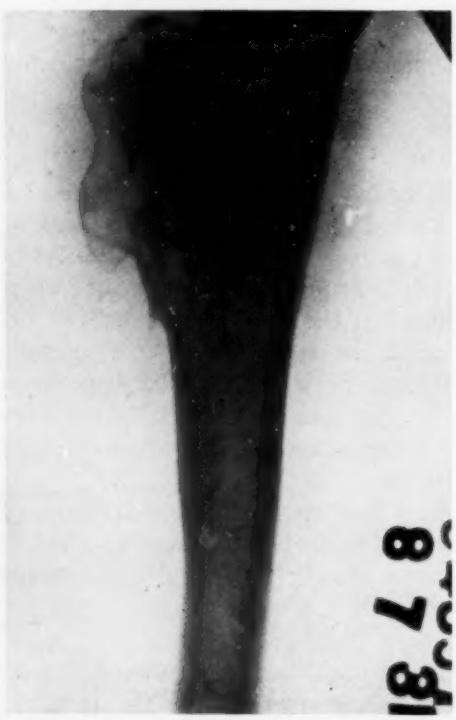


Fig. 1 (P. N. 46012). Osteochondroma arising at the insertion of the deltoid muscle in the upper humerus. A shows the anteroposterior view in which the cartilaginous cap is clearly outlined by a smoothly calcified rim and joins at the base with a protrusion of normal cancellous bone. B shows the lateral view interpreted elsewhere as a cyst or possible chondrosarcoma. The anteroposterior view was the only one taken at first, and illustrates the importance of taking roentgenograms of bone lesions in more than one direction.

(2) a neoplastic cartilaginous cap sitting upon that base; (3) a definite calcified de-

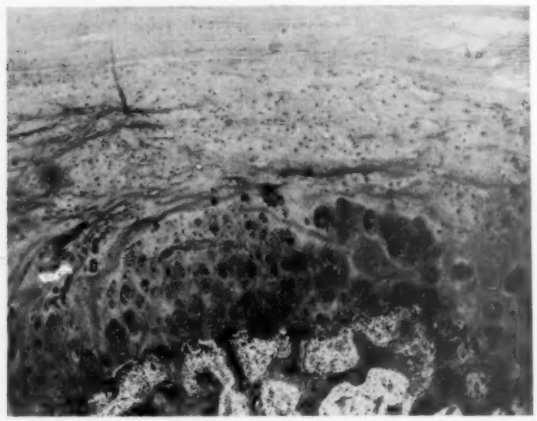


Fig. 2 (P. N. 26392). Photomicrograph showing the microscopic structure of a benign osteochondroma. From above downward, we see fibrous tissue, fetal cartilage, adult calcified cartilage and at the bottom cancellous bone. This order also represents the cycle of development in these tumors.

Fig. 3 (P. N. 35720). A benign osteochondroma with an overlying bursal sac. The calcification in the bursa overlying the ossified tumor is one of the rare diagnostic findings in these growths.

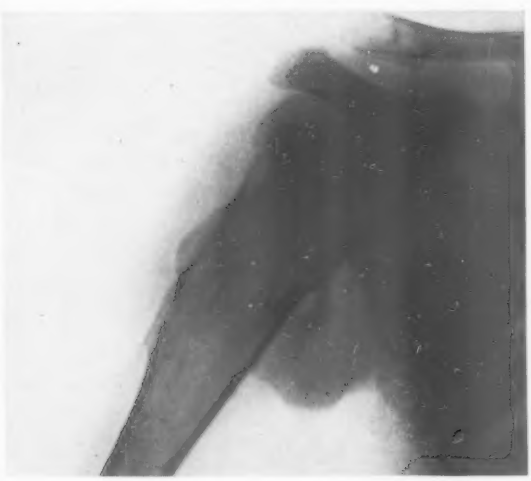


Fig. 4 (P. N. 28539). Roentgenograms in a case of hereditary deforming chondrodysplasia. In A is shown the roentgenogram of both knees. Multiple exostoses extend in the direction of the tendon pull and the metaphyseal regions beneath are broadened, giving the knee joints a "squared-off" appearance. In B further exostoses are shown on the shaft of the humerus, two with a broad base and one, on the medial aspect, of the pedicle type.

marcation which shows its benign character; (4) a relation to muscle emphasized by the direction of the growth which is in the line of the muscle pull; (5) there is a general widening of the shaft in the affected region.

This case shows the importance of taking views in two different directions. The roentgenologist could not interpret the

semi-lateral view. It was thought to be a chondrosarcoma. When the anteroposterior view is taken, the base or pedicle which establishes the diagnosis as a benign lesion, is readily visualized.

The microscopic structure shows the connective tissue entering into the tendon, the early cartilage, the fully developed cartilage, the calcified cartilage and the bone substance forming this osteochondroma (Fig. 2).

The frequent sites for osteochondromas are at the point where the quadriceps tendon attaches, and at the adductor tubercle providing insertion for the adductor magnus. A rather rare form of complication is a bursal sac with calcification overlying the exostosis (Fig. 3). Such a complication does not alter the benign character of the growth but a secondary bursitis, such as there was in this case, may aggravate the symptoms.

The treatment for these lesions is noninterference unless they give symptoms due to pressure on nerves or blood vessels. If accompanied by such symptoms, they can be chiseled off safely if the line of incision or excision passes through the normal cancellous bone forming the base or pedicle. When giving symptoms of growth, the lesion must be watched by repeated roentgen examination and then, if growth is rapid, the possibility of malignant change must be considered. This will be discussed later.

MULTIPLE EXOSTOSES

Benign exostoses or osteochondromas may be multiple (Fig. 4, A and B). Such a case is illustrated and shows multiple outgrowths on the femurs, on the tibia, with malformation in the accessory bones of the foreleg and the ulna of the forearm. This is perhaps the easiest of all bone tumors to diagnose from the roentgenogram. In the first place, it is characteristically multiple with pedicle exostoses; secondly, there is bending and malformation in the accessory bones of the forearm and foreleg; third, there is characteristic malformation of the metaphyseal region so we have a squaring off of the bones in the region of the knee joint, and fourth, there is a distinct familial history or hereditary factor behind most of these cases, so if roentgenograms of bones of other members of the family are made similar deformities are disclosed. Whenever an exostosis is accompanied by the squaring off of the metaphyseal region, films of other bones must be taken in order to find such multiple cartilaginous exostoses or so-called hereditary deforming chondrodysplasia. Like the single exostoses just described, these growths may also undergo malignant change. The treatment in ordinary benign cases is to wait until the patient reaches the age of about twenty-two, for these growths may spontaneously regress or may increase in size or appear in other areas during the growth period. At this time, if there is marked deformity, plastic operations may be considered, or again if there is secondary growth with enlargement, excision, or if there is pressure that develops at any time on nerves or blood vessels, excision may be employed.

CHONDROMAS

There is another type of cartilaginous growth which instead of protruding from the periosteal region in the direction of muscle pull, is imbedded within the bone and forms a central area of rarefaction (Fig. 5). This is the benign enchondroma or so-called chondromyxoma. These lesions are most frequent in adults in the small bones of the hands and feet, and are particularly prone to occur in the phalanges of the hand. They are also distributed quite often about the sternum or about the spine. In other words, the benign central chondroma is most frequent in those parts of the skeleton where a maximum number of joints or articular surfaces exist in the hand and foot, the spine or the ribs. They represent aberrant joint surfaces and have a composition akin to the osteochondromas because the same precartilaginous connective tissue which is found in tendons is also found on the joint surfaces. In the

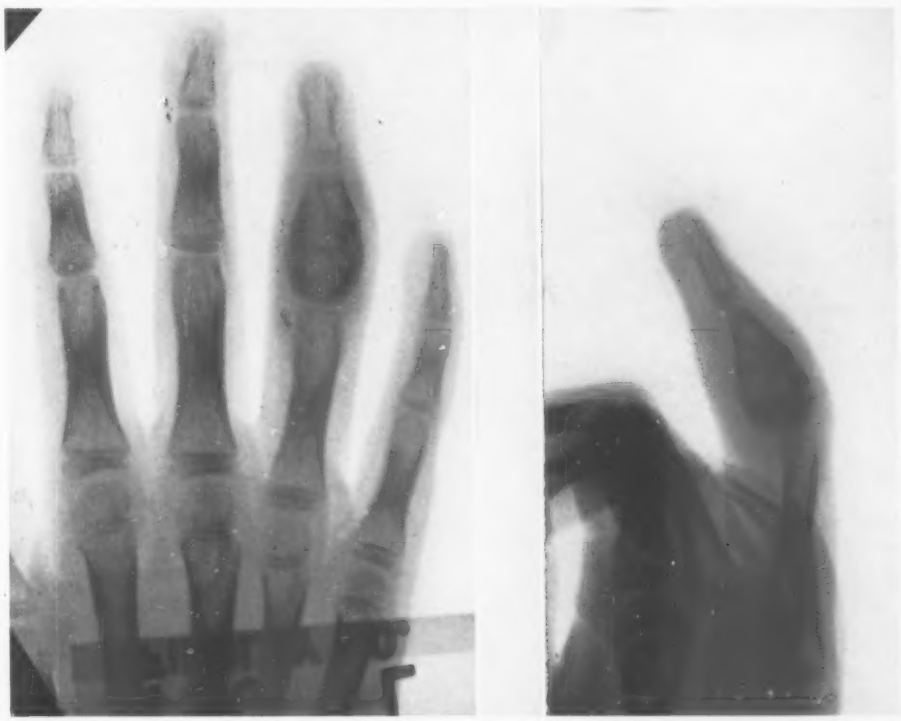


Fig. 5 (P. N. 28365). A benign central chondroma in the phalanx of the fourth finger. The lesion has a smooth expanded shell and irregular trabeculae in the area of rarefaction. This is the most common tumor appearing in the phalanges and in this location is uniformly benign.

embryo, strands of this tissue cut across the bone at right angles to form joints. Such aberrant strands later in life, following trauma or some other factor, may proliferate and give rise to a cartilaginous tumor, usually with a good deal of adult cartilage, but very often extremely cellular.

The tumor is characterized in the roentgenogram by the expansion of a shell, the escape of the tumor directly beyond the shell and a trabeculation which is finer than that seen in cysts or giant cell tumors and best termed multiloculation. There is also a fine stippling produced by calcareous deposits. In the small bones of the hands and the feet (os calcis and astragalus excluded), these tumors are uniformly benign in character regardless of their microscopic appearance. Here they may be left alone or if giving pain can be curetted, followed by thermal or chemical cauterization. Irradiation is not necessary.

The benign chondroma in a central location is common about the sternum and in fact the most usual central tumor of the sternum is a benign chondroma. But in a large bone like the sternum or any of the long bones, these tumors are always potentially malignant.

The case illustrated (Fig. 6, A and B) has been followed for over eighteen years. The first roentgenogram was made in 1913, and shows a multiloculated stippled growth within an expanded shell of the bone. The tumor is in the sternum. The second roentgenogram was made five years later and at that time a malignant change was suspected because of the more pronounced stippling and the escape of the tumor beyond the capsule and because of its location in a large bone. The patient had deep roentgen therapy during that time which was intensified when malignant change was suspected. The growth had been checked fairly satisfactorily until the last year when

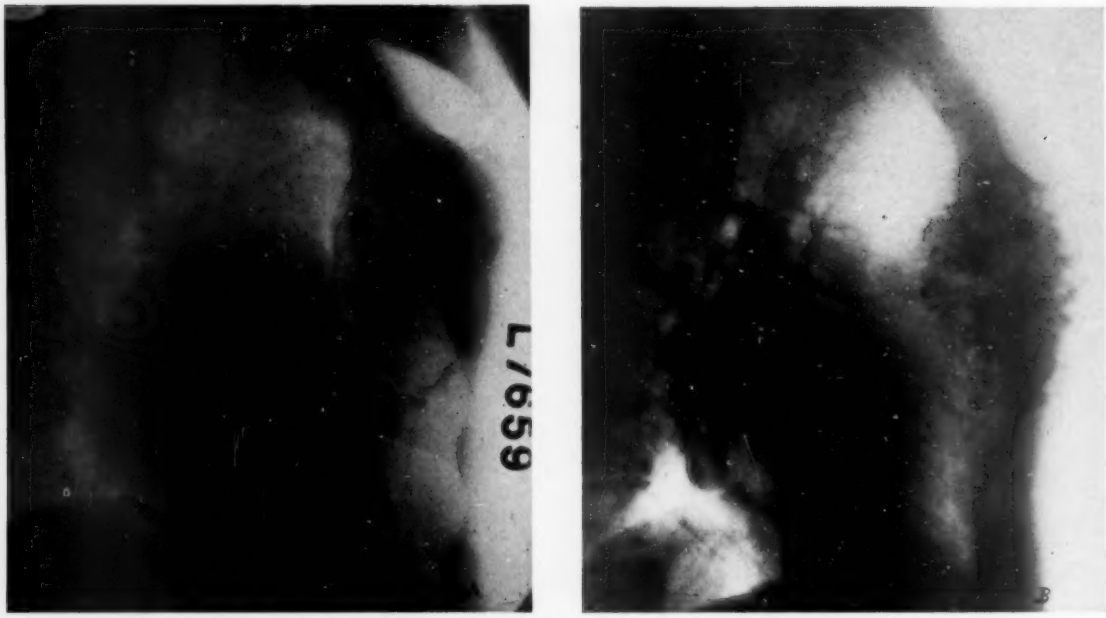


Fig. 6 (P. N. 32482). Benign central chondroma of the sternum undergoing malignant change. A shows the central expansile lesion with an intact bone shell, a definitely benign chondroma at this stage. B shows the same lesion five years later. The diffuse stippling and the irregular extension beyond the bone shell indicate early malignant change. In 1932, eighteen years after the first observation, secondary nodules appeared about the chest wall. The patient died early in 1935 with marked compression of the mediastinal organs but without distant metastasis.

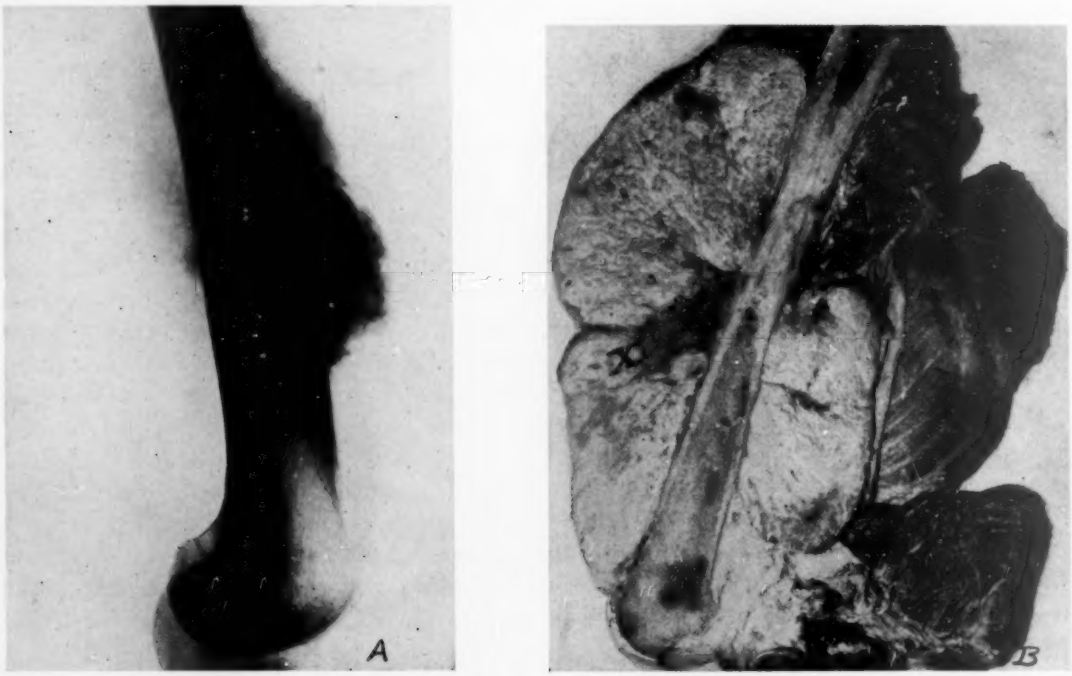
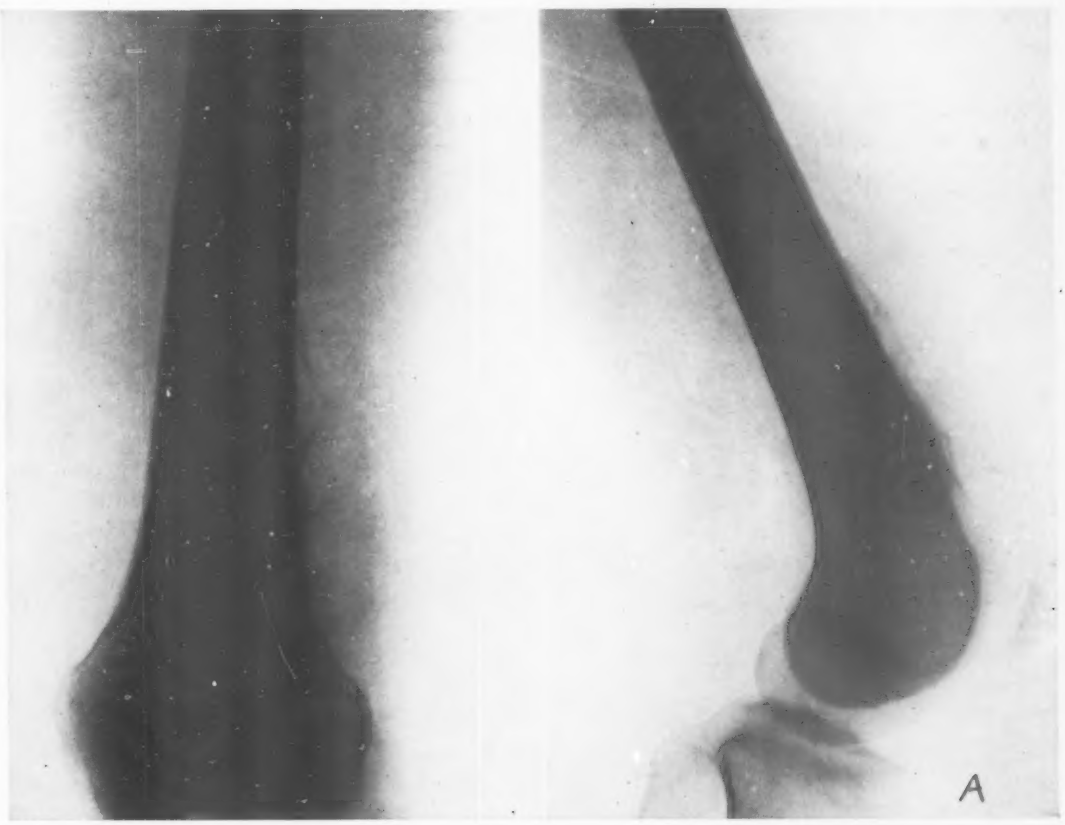


Fig. 7 (P. N. 39952). Secondary chondrosarcoma arising in a benign exostosis. A shows the roentgenogram nearly two years before the amputation. The irregular cap of the exostoses and the new periosteal bone formation extending along the shaft and into the soft parts indicate the malignant change. B shows the gross specimen after amputation. The original exostosis indicated by x and is surrounded by marked sarcomatous proliferation.



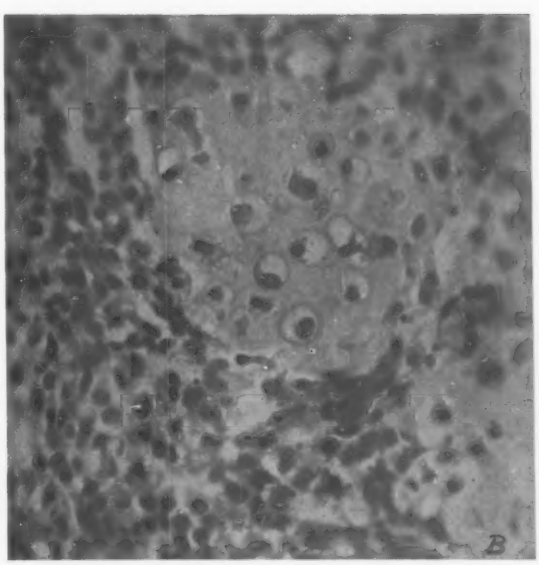


FIG. 8 (P. N. 39114). Roentgenogram and photomicrograph of primary chondrosarcoma. A shows the anteroposterior and lateral views of the lesion in the roentgenogram. A faintly visible periosteal shadow is seen in the region of the adductor tubercle. The cortical and medullary bone beneath are still intact. B shows the photomicrograph. An island of cartilage is surrounded by a very cellular precartilaginous connective tissue of malignant character.

multiple nodules appeared over the chest and over the surface of the sternum projecting through the skin. Shortly afterwards the patient died because of extension of the tumor into the mediastinum.

We may conclude that these central chondromas are potentially malignant in large bones and can give rise to secondary chondrosarcoma or secondary osteogenic sarcoma containing cartilage. We must be on the lookout for such malignant change. When in a deep location it is better to avoid local excision, knowing if operation is attempted, complete removal of the growth must be achieved since any tissue left behind will readily transplant and eventually metastasize.

The possibility of malignant change exists in the benign exostosis as well as the benign chondromas. Such a case in which

a secondary growth has proliferated at the site of an exostosis arising from the femur is illustrated (Fig. 7, A and B). In the roentgenogram a large shadow extends with hazy margins into the soft parts and

Fig. 9 (P. N. 40318). Typical sclerosing osteogenic sarcoma in the lower femur. The roentgenogram shows sclerosing of the marrow cavity and dense periosteal new bone, radiating outward from the metaphyseal region of the lower femur.

invades the bone, eradicating evidences of the former exostosis. In the gross specimen, the pedicle is definitely visible. The amputated specimen clearly depicts what has occurred. Malignant change has taken place in the cartilaginous cap, sarcomatous tissue proliferating about the entire bone giving rise to this tremendous malignant growth.

When secondary to a benign growth, either of the osteochondroma or chondroma type, this form of chondrosarcoma which occurs usually in adults and contains embryonic forms of cartilage can be treated more successfully than a primarily malignant growth.

Radical operation results in 25 per cent of permanent cures. The lesion is controlled only to a slight extent by irradiation.

PRIMARY CHONDROSARCOMA

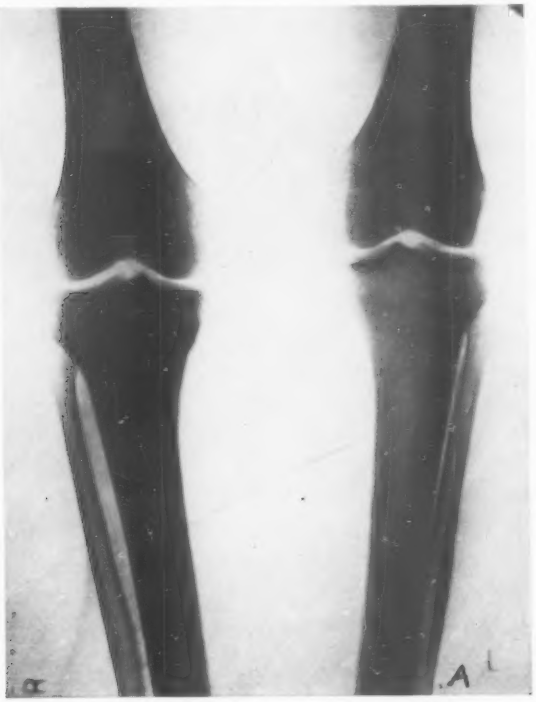
The next illustration (Fig. 8, A and B) shows a practically invisible growth with a few fine radiating spicules infiltrating the soft parts overlying the lower end of the femur. This is a primary chondrosarcoma occurring during puberty. This growth is extremely malignant and in only 4 cases out of about 100 has any form of treatment succeeded in stemming the malignant process. These patients are younger than the cases of secondary chondrosarcoma, usually between the ages of fourteen and twenty. The tumors are not particularly radiosensitive.

Microscopically the growth contains the same early connective tissue giving rise to cartilage, but the bulk of this cartilage is the early fetal form. Primary chondrosarcoma also arises where tendons attach to the bone, but unlike the benign exostosis they are malignant from the very start and pursue a very rapidly fatal course. In the roentgenogram the growth presents a fairly invisible periosteal tumor without involvement of medullary or cortical bone. The swelling on palpation always seems larger than depicted in the roentgenogram.

SCLEROSING OSTEOGENIC SARCOMA

Another form of osteogenic sarcoma which does not often contain cartilage is the sclerosing osteogenic sarcoma (Fig. 9). This is the easiest form of bone sarcoma to interpret in the roentgenogram. It gives a characteristic "sunburst" with many radiating spicules of bone and obscures the marrow cavity. It is generally on the shaft side of the epiphyseal line in patients between the ages of fourteen to twenty-five. It is not radiosensitive and is best treated by amputation. It is not necessary to await this radiating formation of spicules to make the diagnosis.

In earlier cases the first sign of tumor is clouding of the marrow cavity with faint roughening of the periosteum, seen in a young patient under twenty-five. This peculiar mottling or density of the marrow cavity in the metaphyseal region when compared to the normal side is sufficient to make the diagnosis of sclerosing osteogenic sarcoma (Fig. 10, A and B). It is a highly differentiated form of sarcoma. It represents an endpoint of ossification and is composed histologically of large osteoblasts which lay down an irregular osteoid substance.



There is also a benign form of tumor which may give rise to secondary osteogenic sarcoma of this type. It is important for both roentgenologists and surgeons to know how and when such a growth may arise. This benign type of growth is myositis ossificans (Fig. 11). In the roentgenogram the growth is on one side of the bone only. There is no obscuring of the marrow cavity. There are no radiating spicules. There is no periosteal involvement proceeding beyond the points of ossification. The best treatment is non-interference. The disease soon becomes stationary and thereafter may subside and disappear. If operated upon, it may recur and once a myositis ossificans recurs, a statement as

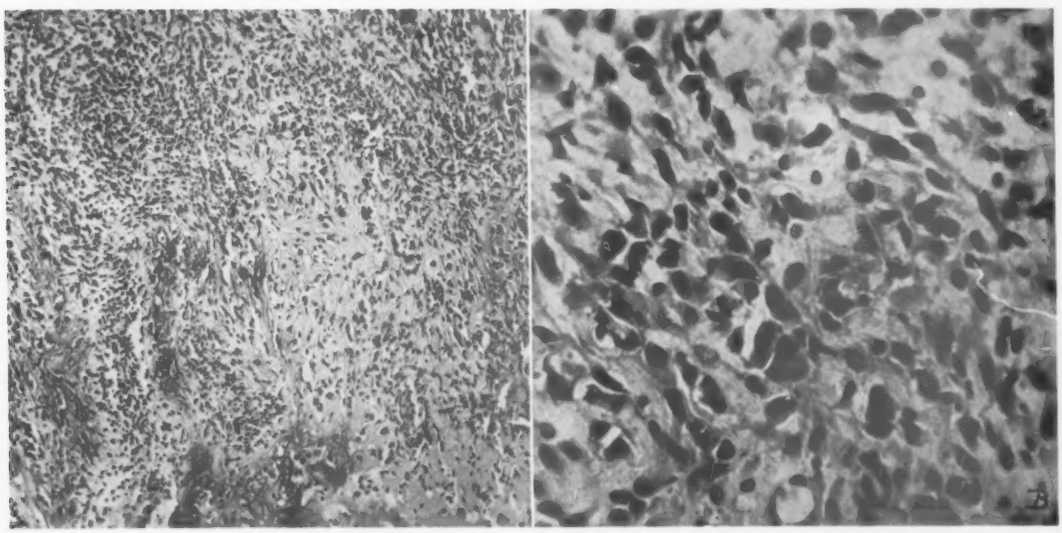


Fig. 10 (P. N. 40876 and 36848). Roentgenogram and photomicrograph of an early case of sclerosing osteogenic sarcoma. In A sclerosis of the marrow cavity with a faint periosteal reaction indicates the early invasion of the metaphyseal region by sclerosing osteogenic sarcoma. Abundant periosteal new bone of the radiating type is a later feature of the disease. B shows the low and high power photomicrographs characterized by the proliferation of malignant osteoblasts and irregular osteoid trabeculae.

to whether it is benign or malignant becomes practically impossible unless the ultimate clinical outcome is awaited.

The myositis ossificans which is illustrated in Figure 12 was excised. Despite the excision the growth recurred. The laminated striations of myositis ossificans, with

Fig. 11 (P. N. 40078). Roentgenogram of a case of myositis ossificans. The classical "dotted veil" overlying a wedge of newly formed bone is seen casting an extra-osseous shadow along one side of the femur. The edges of the new bone are smooth and parallel.

the indefinite ossifying edge of sarcoma superimposed, is depicted in the roentgenogram taken following the recurrence (Fig. 12, A and B).

The terminal ossifying stage of bone development thus gives rise to either primary or secondary sarcoma in which there is a tremendous amount of new bone but little or no cartilage. This type of osteogenic sarcoma is less malignant than those tumors of the sarcoma group which contain cartilage. None of the sclerosing sarcoma cases in our series have been benefited by irradiation. However, one-third of all of them have been cured by amputation and are living over five years. In these cases, amputation may be performed upon a diagnosis made from the roentgenogram alone, but biopsy should be performed under tourniquet as a precautionary procedure.

OSTEOLYTIC FORM OF OSTEOGENIC SARCOMA

Another form of osteogenic sarcoma belies the name of osteogenic sarcoma because instead of producing bone, it destroys it. This is the osteolytic form of osteogenic sarcoma (Fig. 13, A and B). A very typical history is usually obtained in young patients under twenty years of age, who come in with symptoms of pain for about two months, fever about 101° F., white count of about 11,000 and tenderness and swelling over the metaphyseal region of a long bone. The clinical diagnosis is frequently osteomyelitis. The surgeon operates; he encounters blood instead of pus. The fact that these patients have a history of two months' tenderness instead of two weeks', that the bone destruction is late instead of early, is overlooked. Neither cultures nor frozen sections are made. Drainage tubes are inserted and the wound becomes secondarily infected. Thereafter no one can make the diagnosis and the patient is not properly treated until any form of treatment is too late to be effective. We must be on the lookout for this form of osteogenic sarcoma which arises from the endosteum. It produces bone destruction with periosteal lipping. It may be accompanied by a slight fever and leucocytosis, it may simulate a bone cyst, but there is no shell as in a bone cyst and the bone destruction does not extend to the other side of the marrow cavity before perforation of the cortex occurs with periosteal reaction.

This osteogenic sarcoma which destroys bone is composed of big osteoblasts and

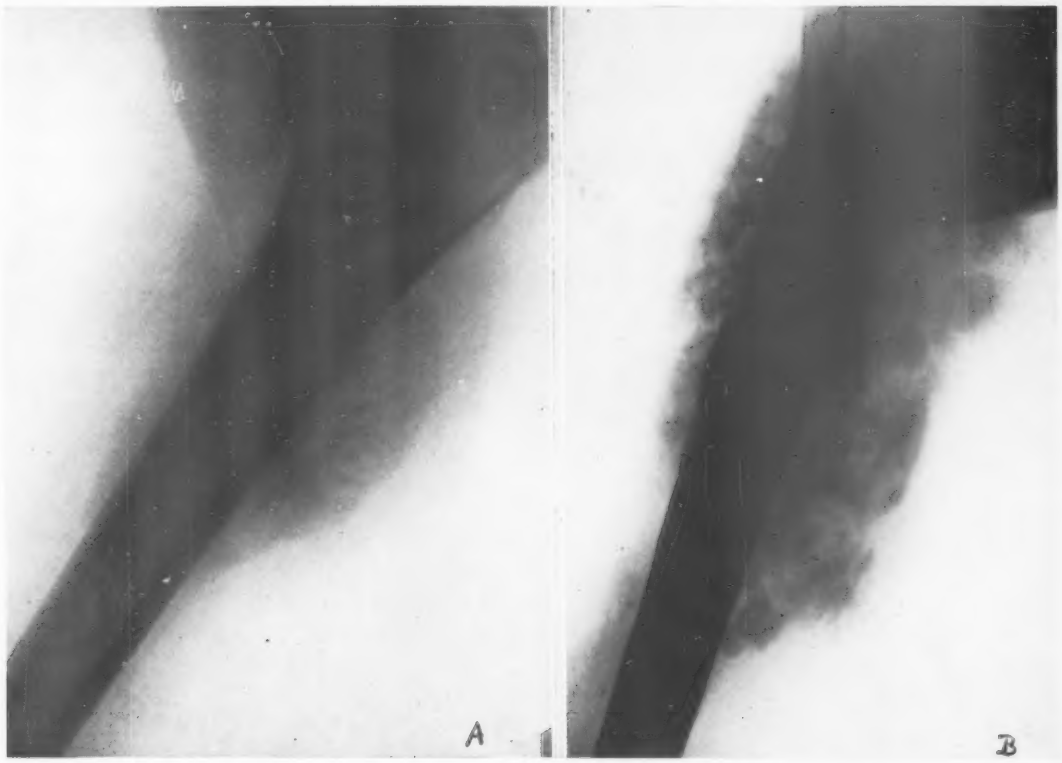


Fig. 12 (P. N. 36014). Roentgenograms of sarcoma arising in myositis ossificans. A. In the roentgenogram before operation, typical myositis ossificans is present along the lateral margin of the humerus. On the medial margin there is a less definite shadow suggesting the possibility that malignancy is already present. B. The roentgenogram of the recurrent growth after operation shows diffuse invasion of the soft parts by an irregular ossifying lesion typical of sarcoma.

malignant spindle cells. The reason why bone formation is so scarce is because this tumor arises in cancellous bone, and cancellous bone formation is dependent upon a previous storage of calcium in cartilage. There is not sufficient cartilage available after birth in this region to enable this type of tissue to ossify, hence it opens up the marrow spaces, becomes hemorrhagic and forms the so-called malignant bone cyst or bone aneurysm, of the older authors.

The treatment is primary amputation following an exploration.

Irradiation of these tumors in the form of deep roentgen therapy has not proved successful, but where, because of refusal to consent to amputation or because of mistaken diagnosis the complete operation is not performed, the lesion has been held in check for two to three years.

The case illustrated had radium implantation and is living two and one-half years later. When the amputated specimen was examined microscopically, no tumor was found. We often get an osteomyelitis with any form of radium implantation in the bone that often necessitates amputation. This must be borne in mind before adopting this form of therapy.

CHONDROBLASTIC SARCOMA

One other form of osteogenic sarcoma which is causing considerable discussion in certain circles is a form of tumor which in the roentgenogram is like other cartilaginous forms of osteogenic sarcoma (Fig. 14). There is a periosteal reaction, a faint translucent shadow beyond the bone and a slight amount of bone destruction in the cancellous spaces and in the subcortical re-

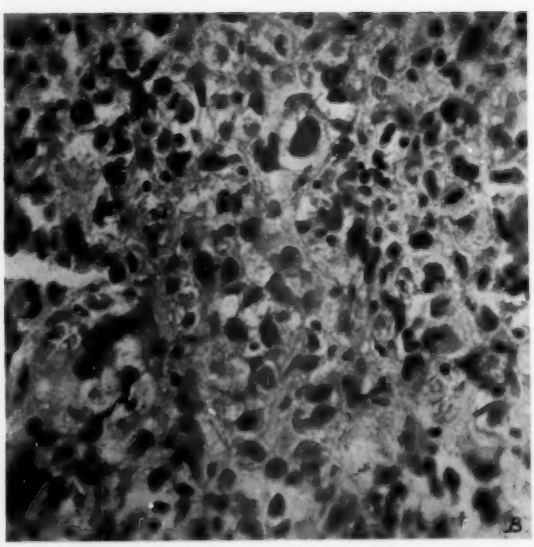


FIG. 13 (P. N. 41194). Roentgenograms and photomicrograph of the osteolytic form of osteogenic sarcoma. A. The lateral and anteroposterior views depicting a bone destructive lesion in the upper tibia which has eroded the marrow cavity and the cortex and produced a slight periosteal reaction. The perforation of the bone shell before erosion has proceeded across the marrow cavity to the cortex of the opposite side is against the diagnosis of benign bone cyst and in favor of osteolytic sarcoma. B. The photomicrograph bears out the diagnosis of osteolytic sarcoma showing a proliferation of large abortive malignant osteoblasts with numerous mitotic figures.

Fig. 14 (P. N. 35226). Roentgenogram of chondroblastic sarcoma. There is a rarefied area at the epiphyseal line of the lower femur and above this an extension of bone destruction into the marrow cavity beyond.

Fig. 15 (P. N. 35226). Gross specimen of chondroblastic sarcoma. The relation of the tumor mass to the unossified epiphyseal line is clearly seen. The tumor has fungated through the site of the curettement into the soft parts and is also extending up the marrow cavity.

gion. The patient is practically always between the ages of fourteen and nineteen. The reason for the narrow age limits is shown in the gross specimens.

The tumor arises from a proliferation of cartilage from the unossified epiphyseal line and invades the subperiosteal spaces (Fig. 15). Being cartilaginous, it casts little or no shadow and hence the roentgenogram does not indicate the exact size of the growth.

The difficulty in interpretation is not in the roentgenograms but in the microscopic section, because of the presence of numerous giant cells that wander into the lesion to resorb the cartilage (Fig. 16). Codman and others have interpreted this type of cartilaginous growth containing giant cells as a form of giant cell tumor. We believed it to be a cartilaginous sarcoma or form of osteogenic sarcoma containing cartilage.

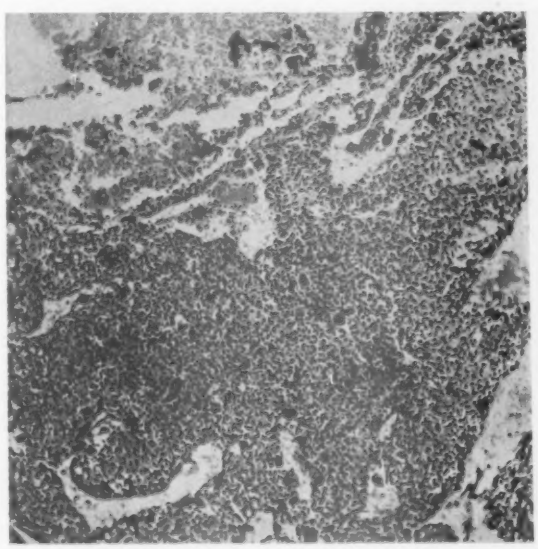


Fig. 16 (P. N. 35226). Photomicrograph of chondroblastic sarcoma showing a proliferation of chondroblasts, small areas of calcified cartilage and numerous giant cells.

However, while some of these patients have died after amputation, some of them have responded to deep roentgen therapy or to radium implantations or a combination of radium and roentgen irradiation. We are beginning to feel that this tumor may be radiosensitive and should have the benefit of deep roentgen therapy before radical amputation or excision or resection.

elliptical area of bone destruction within the marrow cavity, expands the cortex symmetrically on either side and leads to a pathologic fracture. The shell of the bone is rarely broken except by fracture. The outstanding diagnostic points are a patient under fifteen with involvement on the shaft side of the epiphyseal line, central bone destruction, with fusiform expansion of the shell.

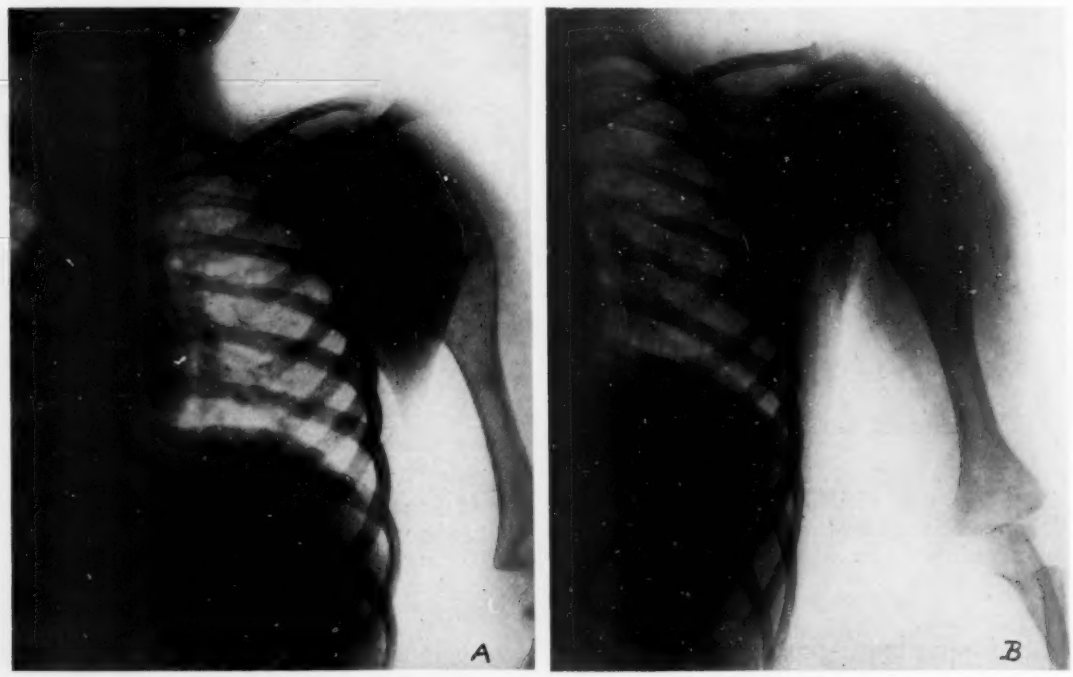


Fig. 17 (P. N. 47286). Roentgenograms of the unhealed and healing phase of a benign bone cyst. A. July, 1931—shows a fusiform expansile lesion in the shaft of the upper humerus, a typical benign bone cyst. B. January, 1932. There is beginning reossification after curettement in the same lesion six months later. The patient is only four years of age. In January, 1933, one year later, there is recurrence of the lesion.

BENIGN BONE CYST

Another group of tumors related to bone formation, arises not in connection with the formation of cartilage or bone, but rather the resorption of calcified cartilage which takes place before the bone is laid down in the cancellous spaces. This group includes the benign bone cyst and the various varieties of osteitis fibrosa and the benign giant cell tumor. The illustrations show a classical bone cyst (Fig. 17, A and B). Such a lesion occurs in a patient under fifteen, produces in the roentgenogram a fusiform

Fixation is the best method for treating the ordinary type of bone cyst that comes under observation with a pathologic fracture. If the tumor tends to recur or cause trouble, it can be curetted and crushed or curetted and filled with bone chips. Roentgen therapy (not in large doses) can be tried to produce a slight radiation osteitis which may help in ossifying the shell after the irradiation is discontinued. However, there are other forms of bone cyst which are much better treated by irradiation than this type. This type, to repeat, is

best treated by simple fixation for fracture, crushed, or let alone. It is a benign tumor and rarely causes symptoms.

ACUTE BONE CYST

There is a type of bone cyst occurring in a patient under fifteen on the shaft side of the epiphyseal line which is best treated by irradiation. The case illustrated is from Dr. LeWald who was kind enough to present the films to the laboratory (Fig. 18, A and B). The patient was successfully treated by deep roentgen therapy. Diagnosis is dependent upon the age of the patient, which is under fifteen, a tumor on the shaft side of the epiphyseal line, fusiform expansion about an area of bone destruction, and a duration of symptoms under six months. Although this acute or active form of bone cyst shows on microscopic section cysts lined by giant cell tissue, it differs from giant cell tumor in its location and occurs in younger patients. It is sometimes called the giant cell variant of the bone cyst. The type of irradiation best given is prolonged doses with a voltage less than the maximum employed in the usual deep roentgen therapy. Giant cell tumor occurs in the epiphysis of adults after the age of twenty.

Fig. 18 (P. N. 46340). Roentgenogram of an acute bone cyst treated by irradiation. A, the lesion before irradiation; B, after irradiation. Note that the rarefied lesion is on the shaft side in a young patient in whom the epiphyseal lines are not yet ossified. This is not a giant cell tumor which is characteristically a lesion of adults and occurs on the opposite side of the line in the epiphysis.

MULTIPLE OSTEITIS FIBROSA

There is another type of bone cyst that is multiple in form and may affect many bones (Fig. 19, A and B). This is the type in which the cysts involve the entire length of the shaft and invade other bones as well. This type of multiple bone cyst is termed von Recklinghausen's disease, this term now being restricted to the multiple

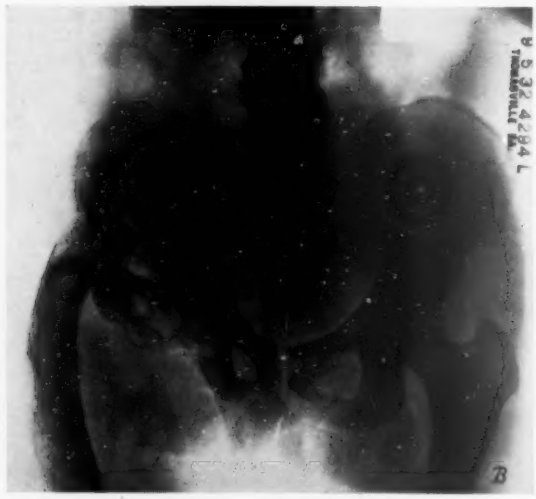


FIG. 19 (P. N. 46918). Roentgenogram of multiple osteitis fibrosa, associated with parathyroidism. Many bones of the skeleton are diffusely involved by cystic change accompanied by bending deformity.

form. It is important in all these cases not only to roentgenograph the other long bones in a search for bending and distortion and multiple cyst formation, but also to study the blood calcium and blood phosphorus. The serum calcium is usually elevated above the normal limit of 10 to 12 mg., and the phosphorus may fall as low as 1 mg., whereas secretion of calcium in the urine may be eight or ten times normal on a low calcium intake. In such cases with positive blood chemistry findings it is necessary to investigate the parathyroids. Removal or irradiation of the parathyroids has frequently resulted in beneficial results and regression of these tumors.

On the other hand, these tumors may regress without the removal of the parathyroids and they may occur without showing abnormalities in the blood chemistry. In other words, there is reason to believe that parathyroidism like hyperthyroidism may have remissions and exacerbations over prolonged periods and cause the bone cysts to multiply and to regress. We are not always fortunate enough to examine the blood at the time when the blood chemistry is positive. These tumors, however, should always be studied from the standpoint of serum calcium and phosphorus and for the possibility of parathyroidism. In cases of this type the skull is markedly thinned and the long bones twisted and cystic.

DIFFUSE OSTEITIS FIBROSA

Other cases of multiple osteitis fibrosa may have no demonstrable blood chemistry changes. The case illustrated (Fig. 20) was followed for ten years. Only a single bone is diffusely involved by the cysts. The serum calcium and phosphorus have been repeatedly negative. Some disturbance in the local blood supply or the regional nerves is to be suspected.

A case in which the patient with such bone involvement had von Recklinghausen's disease of the nerve, and a malignant tumor along the peripheral nerve trunk, confirms the view that multiple bone cysts confined to a single bone extending the entire length of the shaft may be due to trophic neurogenic and not to metabolic disturbance.

Fig. 20 (P. N. 32732). Roentgenogram of diffuse osteitis fibrosa involving a single bone. The bone is bent anteriorly due to increased length. This congenital overgrowth of a single bone accompanied by osteitis fibrosa of the shaft of progressive nature is usually associated with a disturbance of the peripheral nerves of the extremity.

LATENT BONE CYST AND BRODIE'S ABSCESS

There are other forms of bone cyst that have been erroneously interpreted in the literature. An adult with a cystic area surrounded by thick shell of normal bone may have an extremity roentgenographed for other reasons. The lesion is accidentally discovered after twisting the ankle or after a fall with minor symptoms. The diagnosis in such a case is latent bone cyst (Fig. 21).

Another patient with a cyst in the same area but with a sclerosis of the bone about the region may come under observation because of pain and tenderness in the bone, not preceded by trauma. Such a case was operated on and cultured by a prominent surgeon recently and reported as a bone cyst due to infection. Such an interpretation is erroneous. Where a so-called latent bone cyst is the seat of tenderness and swelling and particularly when located in the tibia of a growing adult, the diagnosis is almost invaribly a Brodie's abscess. The case illustrated (Fig. 22) was explored and the cavity found filled with granulation tissue. Microscopic examination of the curetting proved it to be a Brodie's abscess The lesions with a similar appearance in the roentgenogram but without symptoms are benign latent bone cysts.

Fig. 21 (P. N. 42526). Roentgenogram of a latent bone cyst. The lesion is in an elderly adult and was discovered accidentally. Compare with Figure 22.

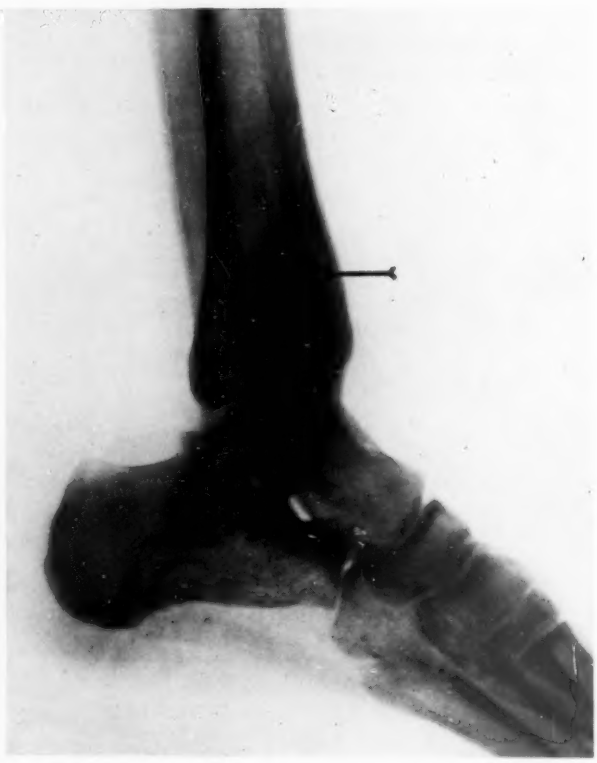


Fig. 22 (P. N. 43646). Roentgenogram of Brodie's abscess. A small rarefied area in the lower end of the tibia surrounded by an area of increased bone density was accompanied by pain and tenderness in a young adult. Compare with Figure 21.

It is important for the roentgenologist to know, then, that Brodie's abscess which occurs usually between the ages of fourteen and twenty and is located most frequently in the tibia may be mistaken or confused with latent bone cyst. Clinically it can always be distinguished, however, because it gives symptoms of pain and tenderness.

BENIGN HEMANGIOMA OF BONE

There is another type of cystic lesion which is frequently confused with the bone cyst. Instead of being central, however, it is subcortical and multiloculated and gives a loose soap-bubble appearance in the roentgenogram. On microscopic examination the tissue is filled with dilated blood spaces. The diagnosis is benign hemangioma of bone (Fig. 23). The first treatment should be irradiation. If the irradiation does not result in ossification of this hemorrhagic tumor, the lesion can be excised or resected. A cure results since these tumors are distinctly benign.

BENIGN GIANT CELL TUMOR

A central bone destructive lesion may involve the ends of the long bones, extending to the articular surface. The lesion is coarsely trabeculated, perforates the bone shell, is globular in outline, extends asymmetrically to one side and abuts on joint cartilage. These are commonly called benign giant cell tumors (Fig. 24, A and B). Giant cell tumors are characteristically in the epiphyseal ends of the bones in adults beyond the age of twenty. They are particularly easy to diagnose when they are in the lower end of the radius because 90 per cent of all tumors of the lower end

of this bone are benign giant cell tumors.

The benign giant cell tumor may be treated by irradiation. If such a tumor is irradiated the patient must be warned that it takes a long time for reossification to occur. We must also be very careful not to irradiate without observing the condition of the neighboring muscles and tendons, because I have seen several such cases irradiated to a point where the leg became entirely useless, due to atrophy of the muscles and fixation of the joint. Benign giant cell tumors may also be treated surgically either by excision or curettement, followed by chemical cauterization. This is the quicker method. We do not believe that many giant cell tumors undergo malignant change. We do not wish to discuss that point here, however, except to say that they are usually benign and can be safely treated as such. It is far better to treat them surgically when in doubt, because this affords an opportunity for microscopic diagnosis.

Fig. 23 (P. N. 25892). Roentgenogram of hemangioma of bone. An intracortical lesion is seen characterized by trabeculation and an expanded shell of bone as thin as an egg shell. The lesion was successfully treated by simple excision.

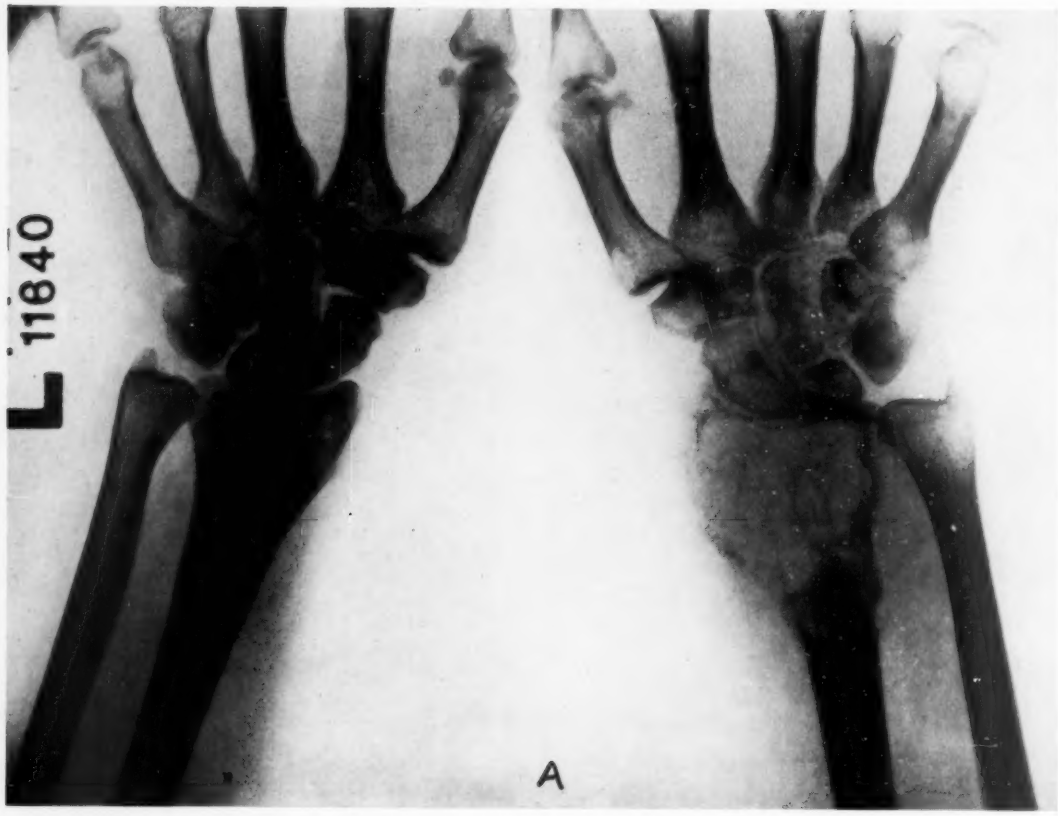
Ewing's Sarcoma

Ewing's sarcoma (Fig. 25) involves the shaft side of the bones in patients under twenty. (A few cases are recorded in adults beyond this age.) The tumor infiltration extends about one-half the length of the shaft. The patient usually has a temperature of about 100° F. and a white count of about 12,000 or 15,000. Bone formation in the roentgenogram is the first sign of involvement with expansion of the shaft, followed by splitting of the periosteum. Secondary bone destruction and the appearance in the soft parts of a tumor which has a gauze-like edge, with continued splitting of the periosteum, are later manifestations.

Ewing's sarcoma is frequently confused with osteomyelitis. An incision is often made under this impression. Blood with tumor tissue pours out and the white tumor tissue is mistaken for pus. A drainage tube is inserted and secondary infection occurs, pus displaces the tumor and accurate diagnosis is eventually impossible. The case illustrated was treated in this manner. The tumor tissue was mistaken for pus. Drainage tubes were inserted; a secondary osteomyelitis occurred, and by the time the diagnosis was settled the patient had metastasis to the brain.

Ewing's sarcoma was originally classified as being a medullary tumor, an endothelioma and primarily bone destructive. We feel that the tumor arises in the Haversian canals and leads to ossification in the periosteal and endosteal zones. The first picture, therefore, is ossification stimulated in these regions followed later by destruction of the cancellous bone, periosteal lipping and the formation of a soft part tumor with the combined picture as illustrated.

A typical case where the shaft is invaded, will show in its early stages expansion of the shaft by new bone formation, and secondary bone destruction with onion peel



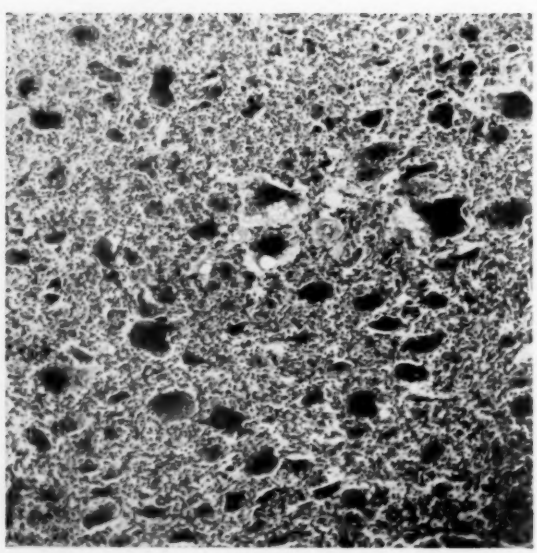


Fig. 24 (P. N. 37708). Roentgenogram and photomicrograph of benign giant cell tumor. A. The roentgenogram shows a globular rarefied lesion thinning and expanding the cortical bone in the epiphysis of the lower radius. B. The photomicrograph is characterized by a proliferation of large multinucleated giant cells.

splitting of the periosteum. Later, a soft part shadow with a definite edge will appear, to be followed in some cases by radiating spicules of periosteal new bone (Fig. 26.

The typical section (Fig. 27) contains small round cells which simulate lymphocytes; grown in tissue culture, the cells also resemble lymphocytic tissue, and the tumor behaves under irradiation as a lymphosarcoma. We therefore lean towards the idea that Ewing's tumor is a lymphosarcoma of bone.

These tumors should be given preliminary irradiation. In the first place, it aids in making the diagnosis between Ewing's sarcoma and sclerosing osteitis of Garré (Fig. 28, A and B). Ewing's tumor responds immediately to initial irradiation. The later results with irradiation unfortunately are not so good with all forms of these tumors, particularly when the deeplying bones are involved. In the second place, an inoperable tumor often becomes operable after irradiation. If in a favorable

Fig. 25 (P. N. 45830). A case of Ewing's sarcoma treated as osteomyelitis. The lesion involves the upper portion of the shaft of the humerus and, in addition to the periosteal reaction laid down in a parallel fashion, causes both bone destruction and new bone formation. The latter predominates.

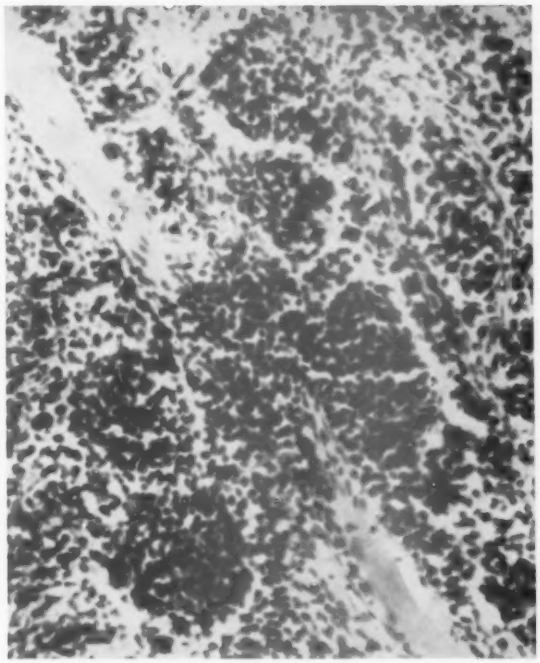


Fig. 27 (P. N. 40530). Photomicrograph of Ewing's sarcoma. A mass of small round cells of the lymphoid type pervade the tumor, separated here and there by a dense fibrous stroma.

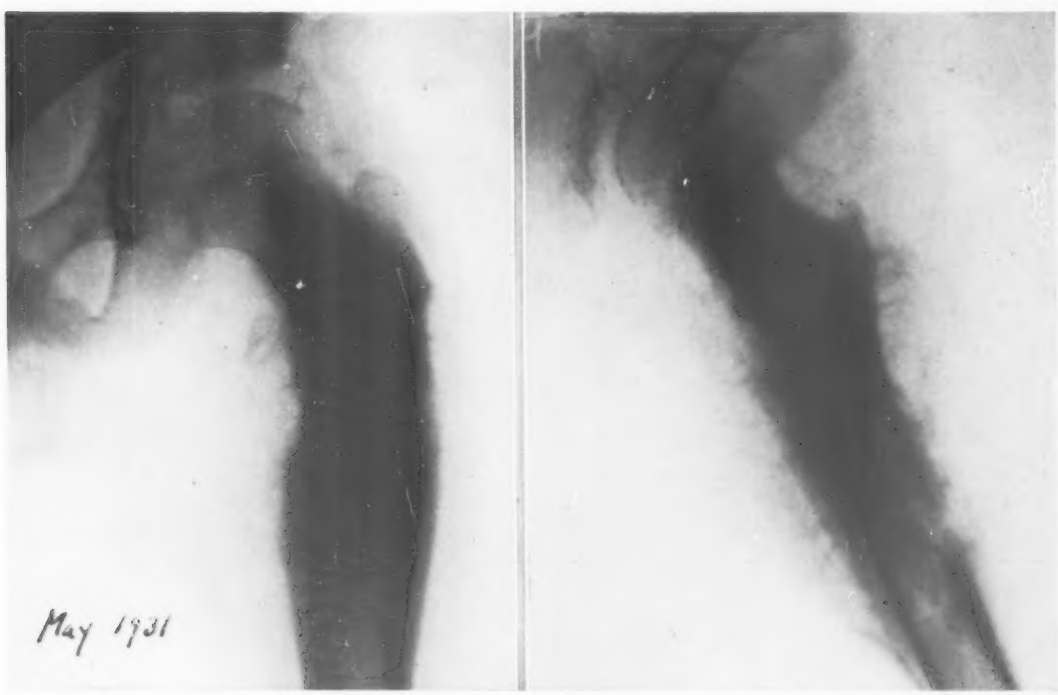


Fig. 26 (P. N. 48780). A typical case of Ewing's sarcoma. In A (May, 1931) is shown the typical roentgenogram of the lesion with expansion of the shaft, parallel periosteal reaction, some bone destruction and a soft part shadow. B (January, 1932) shows the same lesion seven months later. The soft part shadow is increased, the periosteal reaction is more pronounced and some of the spicules of new bone are laid down in a radiating fashion.

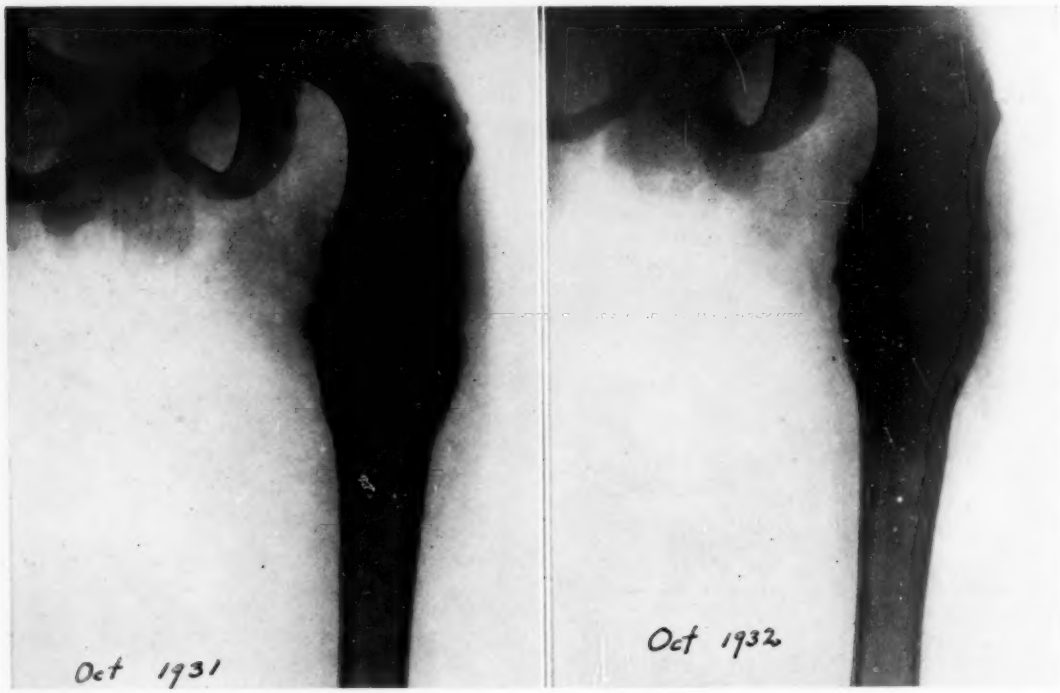


Fig. 28 (P. N. 42666). Roentgenograms of sclerosing osteitis of Garré. In A (Oct., 1931) the film depicts widening and sclerosing of the shaft of the upper femur which is probably sclerosing osteitis but which is difficult to distinguish from Ewing's sarcoma (see Fig. 27, A). In B (Oct., 1932) the lesion is seen one year later. It has not responded to irradiation nor has it progressed after the fashion of Ewing's sarcoma. This second roentgenogram, made one year after the first, confirms the diagnosis of Garré's sclerosing osteitis.

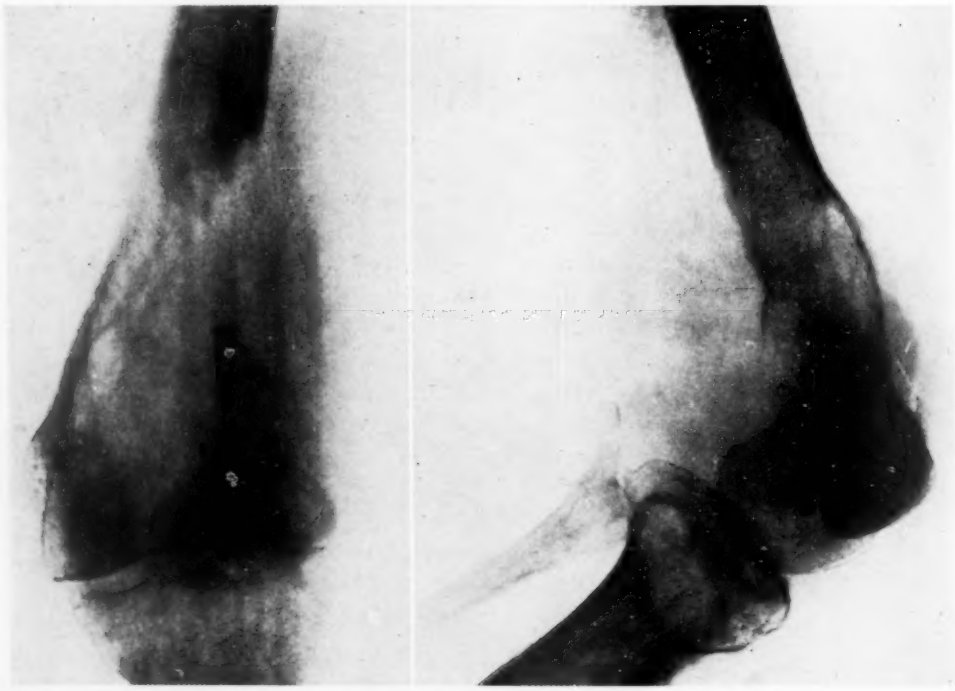


Fig. 29 (P. N. 23407). Roentgenogram of fascial sarcoma invading bone. There is a large soft part shadow not accompanied by a periosteal reaction of new bone.

position, it is best to combine resection with such irradiation. We have followed 3 cases which have recurred after three or four year periods, some of them at the end of four years, in which the original tumor has disappeared under irradiation, but the patient has died of metastases. This experience teaches that after thorough irradiation and when operation is possible and the patient is in good condition, a full course of irradiation should be followed by resection or amputation.

SO-CALLED FIBROSARCOMA OF BONE

So-called periosteal fibrosarcomas are defined by the Bone Registry as fibrous tumors arising in the outer layers of the periosteum. These sarcomas, however, are more often sarcomas of the soft parts, invading the bone by direct extension (Fig. 29). In the roentgenogram the shadow is usually larger in the soft parts than in the bone. The bone is destroyed from without inwardly and there are no definite edges of periosteal reaction. Under the microscope some of these tumors are fibrosarcomas arising in fascia (Fig. 30). These tumors are not particularly radiosensitive and are not very malignant. The case illustrated was cured by amputation. These lesions may be excised and irradiated postoperatively. When they recur they may be amputated and even after five years and two or three recurrences the patients' lives have been ultimately saved.

Another form of tumor often classed as periosteal fibrosarcoma invades bone from without and causes secondary bone destruction similar to the fascial sarcomas just discussed. These lesions are neurogenic sarcoma and do not arise from fibrous tissue (Fig. 31, A and B). The patients usually die regardless of the form of treatment. Thus, although this group may be referred to as spindle cell sarcoma with bone involvement we must realize that one type may be fascial with a low grade malignancy and the other type may be neurogenic sarcoma with a high degree of malignancy.

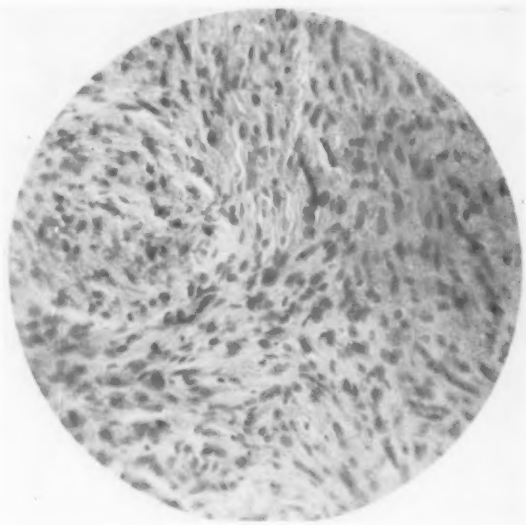


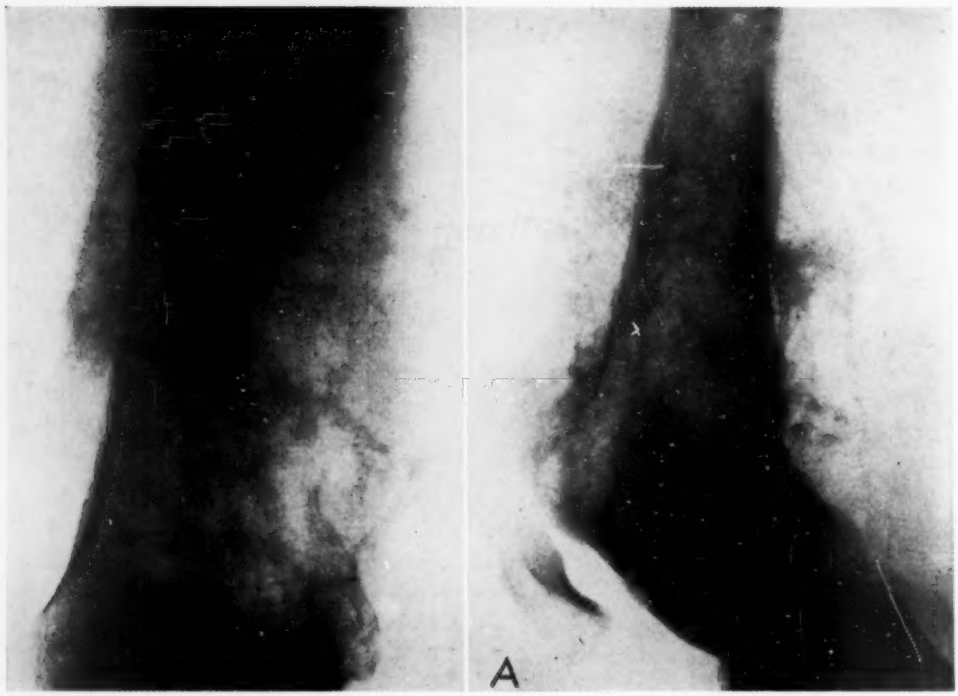
Fig. 30 (P. N. 23407). Photomicrograph of fascial sarcoma of bone. The lesion is of extremely low grade malignancy and the cells are separated by strands of collagen laid down by fibroblasts.

METASTATIC CARCINOMA OF BONE

A large group of bone tumors are metastatic in origin (Fig. 32, A and B). The most frequent metastatic tumors found in bone are those from the prostate, breast, hypernephroma and thyroid. The case illustrated shows involvement of the skull, pelvis and spine and upper end of the long bones. Most metastatic tumors from the breast or prostate involve the pelvis and spine and frequently the skull. In this case bone destruction and secondary bone formation indicate a carcinoma metastasizing from the breast. In other words, the usual breast carcinoma metastasizing to bone gives multiple foci with mottling due to bone formation and bone destruction.

The film of the spine is typical (Fig. 33, A). One vertebra is destroyed and another vertebra more dense, showing the combination of bone destruction and bone formation often observed as an end-result of breast carcinoma.

On the other hand, with metastases to the pelvis, spine and upper end of the long bones and skull in cases with cancer of the prostate there is bone formation with obliteration of the normal bone mark-



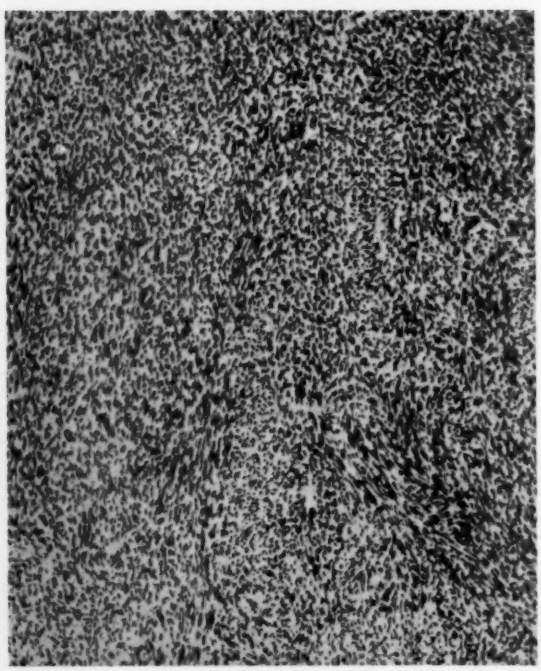


Fig. 31 (P. N. 25453). Roentgenogram and photomicrograph of neurogenic sarcoma invading bone. A shows the lesion invading the soft parts and secondarily infiltrating the bone. Irregular lines of ossification follow the separation of strands of periosteum from the bone. B. The microscopic appearance is typical of spindle cell sarcoma of the nerve sheath. Malignant spindle cells are arranged in fasciculae.

ings (Fig. 34). New bone predominates over bone destruction. Often we are able to diagnose from the roentgenogram alone those cases of metastatic tumors arising from the prostate, because of this predominance of new bone formation.

Carcinomas of the prostate and breast are best treated by radiation therapy which relieves pain and prolongs life. It is the best palliative form of treatment and is of great value in making the differential diagnosis between osteoporosis following disuse and the early signs of metastatic growth in the bone.

Before discussing the other forms of metastatic tumors, we must recall that Paget's osteitis deformans which is characterized by enlargement of the skull may give rise to an increased density in bone and thickening which simulates metastatic carcinoma of the prostate. The illustrations (Fig. 35, A and B) are of a case complicated by ossification in the bones of the face, so-called leontiasis ossium. It is typical Paget's disease clinically. The skull has a

Fig. 32, A and B (P. N. 44594). Roentgenogram of the skull and pelvis in a case of carcinoma of the breast metastasizing to bone. Both bone destruction and new bone formation, giving a mottled effect, accompany the carcinomatous invasion of the bone.

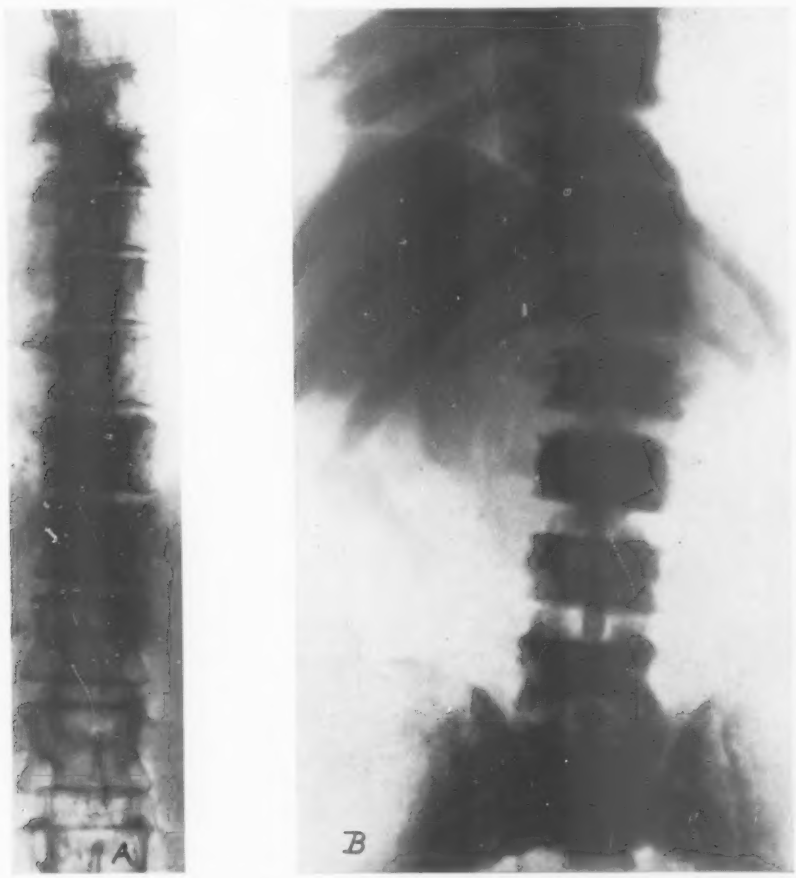


Fig. 33 (P. N. 43072). Contrasting roentgenograms of the spine in cases of metastasis of cancer of the breast and prostate to bone. A. Carcinomatous osteitis of the spine originating in the breast is characterized by rarefaction of some of the vertebrae and increased density in others. B. Carcinomatous osteitis of the spine originating in the prostate is characterized by increased density of the vertebrae obliterating the normal bone markings.

Fig. 34 (P. N. 43964). Roentgenogram of pelvis showing bone metastases arising from carcinoma of the prostate. There are diffuse areas of increased density.

nigger wool appearance, with definite thickening, and is difficult to distinguish from carcinomatous osteitis. But the other bones show characteristics which enable us to make the diagnosis definitely. In the tibia there is bowing, very frequent in Paget's disease, with a wavy deformity in the cortical area, while the striations of the bone are preserved (Fig. 36). Carcinoma of the prostate metastasizing to bone obliterates these bone striae, does not metastasize below the knee and does not give rise to bowing of the tibia. It is very important in cases of Paget's osteitis to be able to tell the patients they are going to live and not to make the mistake of condemning them to death under the assumption that they have metastatic carcinoma.

Involvement of one bone by a single focus is often produced by metastasis to bone from a tumor of the kidney (Fig. 37, A and B). The lesion in such cases is at the site of the nutrient vessels in a long bone, usually the upper humerus or upper femur. The bone is destroyed without evidence of regeneration. This patient had the lesion in the humerus resected and is living two and one-half years later without return of the original symptoms. This section showed so-called hypernephroma or papillary carcinoma of the kidney metastasizing to bone.

A type of tumor frequently confused with metastatic carcinoma of bone—because of the multiple, punched-out areas produced in the skeleton is multiple myeloma (Fig. 38, A and B). A typical plasma-like cell is usually found in sections in most multiple myelomas which arise from a cell that finds its home in the marrow cavity, but which we do not believe is concerned

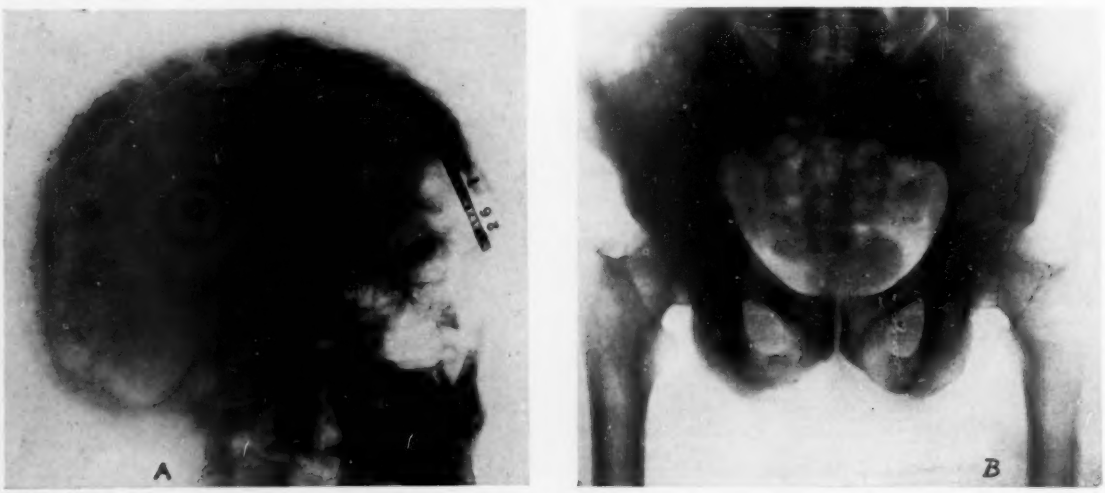


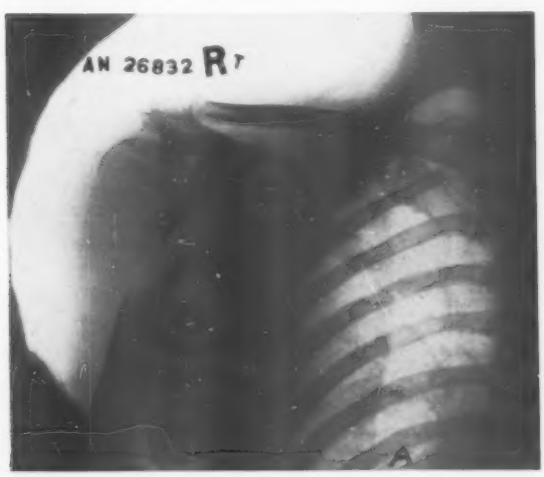
Fig. 35 (P. N. 40728). Roentgenogram of the skull and pelvis in a case of Paget's osteitis deformans. The skull is diffusely mottled and the tables widened by new bone formation, some of which is of decreased density. The lesions are distinguished with difficulty from carcinoma of the prostate metastasizing to these bones. The tibia in this case, however, is diagnostic (see Fig. 36).

Fig. 36 (P. N. 40728). Roentgenogram of the tibia in the case of osteitis deformans shown in Figure 35. The bowing of the tibia, the wavy lines of the cortex and the cystic areas beneath are typical of Paget's disease of bone.

with any type of blood formation or bone production. Multiple myeloma occurs after the age of twenty-three and usually after the age of thirty-five. We have never observed it in children. Most of the long bones, the flat bones and particularly the bones of the trunk are affected. Bence-Jones bodies are found in the urine in 65 per cent of the cases. The lesions are best treated by irradiation.

A peculiar form of periosteal reaction may occur in blood dyscrasias. In some cases the cause is pseudoleucemia or chloroma (Fig. 39, A and B). The patient is usually under twenty, the white count is over 30,000 and the skull is most often involved.

In other cases the tumors are of the lymphoma group (Fig. 40, A and B) and involve the long bones, in children under ten. Areas of destruction are accompanied by a periosteal reaction. The sections from diseased areas reveal lymphosarcoma. Neuroblastoma arising in the adrenals of children and invading bone may produce a similar picture. Like other multiple malignant bone tumors irradiation is the best form of treatment.



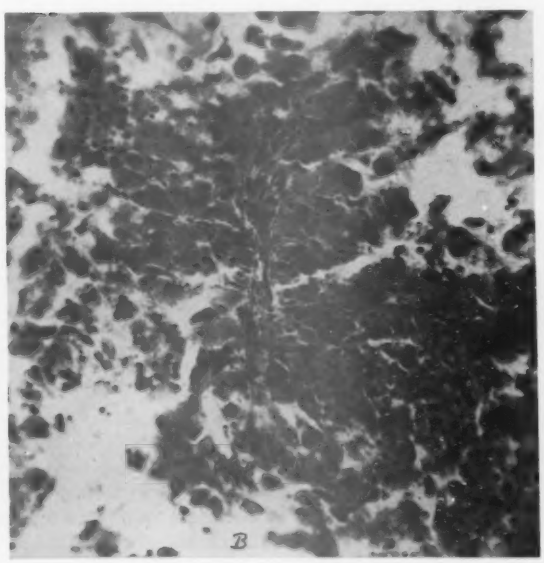


Fig. 37 (P. N. 42906 and 30995). Roentgenogram and photomicrograph of hypernephroma metastasizing to bone. A. The roentgenogram of the bone destructive lesion shows involvement of the neck of the humerus at the site of the nutrient vessels. A pathologic fracture has occurred. B. Photomicrograph of typical so-called hypernephroma or papillary renal carcinoma.

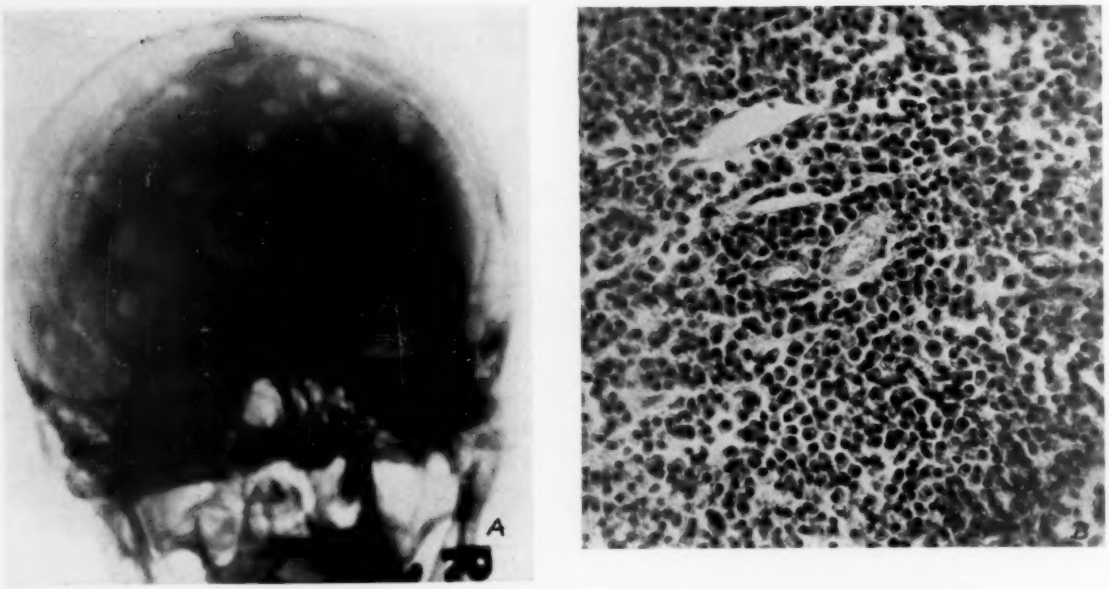


Fig. 38 (P. N. 42108). Roentgenogram and photomicrograph of multiple myeloma. A. The roentgenogram shows multiple punched out areas of small dimension scattered throughout the bone. B. The photomicrograph shows a diffuse proliferation of plasma cells. Both of these are typical of the disease.

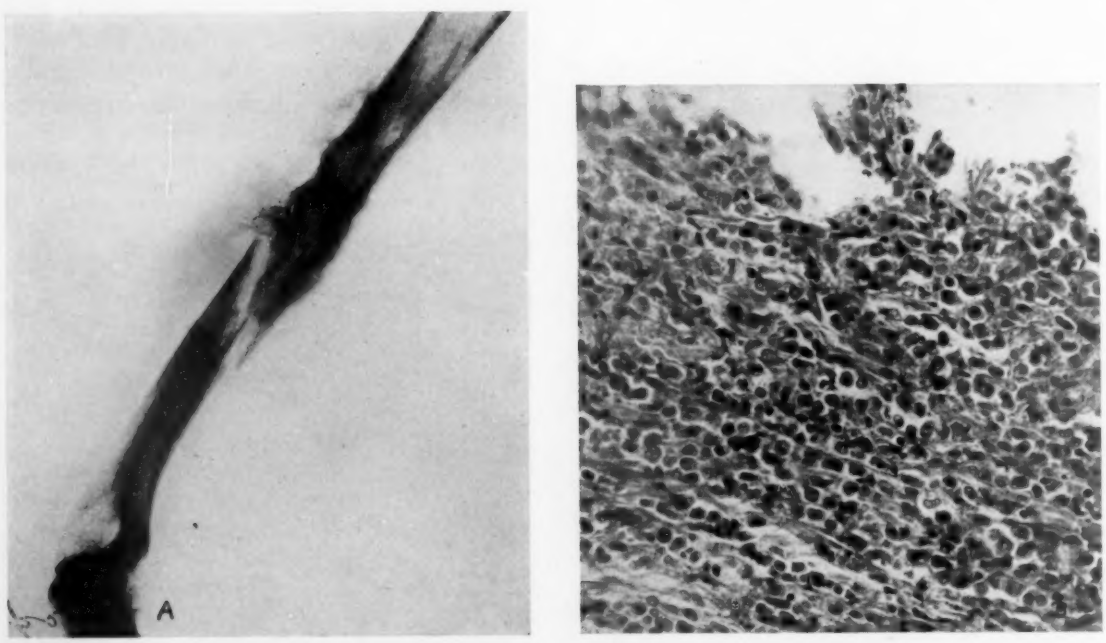


Fig. 39 (P. N. 30441). Roentgenogram and photomicrograph of chloroma. A. The roentgenogram shows both bone destruction in the marrow spaces and periosteal new bone formation. B. The photomicrograph shows cells of the myeloblastic series containing numerous mitotic figures.

Fig. 40 (P. N. 48738). Lymphoma of bone. The roentgenogram shows the pelvis (A) and long bones of the lower extremities (B) with areas of bone destruction caused by reticulum cell lymphosarcoma. Lesions of this character in the bones of children may also be caused by Hodgkin's disease and neuroblastoma arising in the adrenals. .

MUCOCELE OF THE FRONTAL SINUS*

WITH SPECIAL REFERENCE TO THE ROENTGEN ASPECTS AND REPORT OF FOUR CASES

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CHICAGO, ILLINOIS

IN THE past year, two patients with mucocele of the frontal sinus were observed at the Research and Educational Hospital of the University of Illinois. Examination of our files disclosed another proved case and a fourth case which was probably of the same type. A review of the literature revealed numerous case reports of this lesion but comparatively little information relative to its roentgen aspects. The only work found attempting to predicate the diagnostic points from this angle was by Herrnheiser[5] in the German literature. A similar article in the English seems justifiable.

A mucocele is an accumulation and retention of a mucous secretion within a nasal accessory sinus, usually associated with distention of one or more of its walls. Such qualifying phrases as "due to closure of the nasofrontal duct," "following trauma," or "associated with exostosis" are not apparently sine qua non. The involvement may be bilateral but it is usually unilateral.

ETIOLOGY

The exact etiology of mucocele is obscure because, in the long clinical courses of most of these cases, points of history are easily forgotten or over-emphasized. Age apparently is not a factor, the cases including patients from thirteen[7] to eighty years of age. The actual causative factors seem to be:

(1) Obstruction of the nasofrontal duct as the result of: (*a*) congenital absence, (*b*) inflammatory changes, (*c*) trauma, and (*d*) new growths. (2) Enlargement of a retention cyst of a mucous gland. There are cases on record which are sufficiently clear to justify including all of these as causative.

Inflammatory reaction in the region of the nasofrontal duct with closure of the lumen and retention of the secretion seems a plausible explanation for this condition. Turner,[10] however, noted that in half of his cases the nasofrontal duct was apparently patent to a probe. He believes that there was temporary closure and that the viscosity of the secretion prevented drainage later. Dabney[4] encountered a nasofrontal duct large enough to admit a small ethmoidal curette. He subscribed to the theory of cystic dilatation of one of the mucous glands, which, of course, may have been previously inflamed, with closure of its outlet. Strickler[9] substantiates this view with 2 cases showing mucoceles which were seen on routine sinus films and outlined with lipiodol. Howarth,[6] while accepting the inflammatory theory, admits the possibility of a traumatic origin. It requires a special configuration of the ethmoidal cells to explain this; some of the ethmoidal cells apparently come much farther forward than usual and are found in front of the lacrimal bone, bulging into the floor of the frontal sinus. In this position, the cells would not be protected by the ascending process of the superior maxilla as they are normally and trauma might crush them into the nasofrontal duct. Bacher[2] and others report cases of osteomata blocking the duct. Congenital closure is described by Kuhnt and Lack (Dabney[4]).

PATHOLOGY

The pathological findings vary with the etiology and the degree of progress. The changes may be grouped into two divisions: (1) cases without bony distention, and (2) those where there is a bony change.

Reports of cases in the first group are

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very rare; the few cases mentioned belong to the variety arising from a retention cyst. The pathological changes in the walls of these cases have not been described in detail, which leads one to believe that they were not striking. The number of retention cysts may vary from one (Strickler) to many (Dabney). The latter condition seems to be just an accentuation of the condition found in the lining membranes of a high percentage of chronically diseased sinuses. In the group of obstructed non-bone distending cases, Bacher reports one with an osteoma and a thick blue lining membrane containing a thick yellow mucus. There was no demonstrable bony erosion but the medial septum was absent.

The majority of the cases show bone distention. In these, the lining membrane has not the shaggy polypoid appearance found in the routine sinus exenteration but is smooth and more or less atrophic. On section, however, it shows evidence of an inflammatory reaction. This phase follows the inflammatory one and is probably an atrophy due to pressure. The bony walls show a rarefactive type of osteitis on the side toward the distending fluid and usually exhibit proliferative changes in the periosteum away from the sinus. These hyperostotic changes may be very marked, in some cases giving the appearance of an actual exostosis. Their presence has been repeatedly affirmed and denied and evidently varies greatly, depending on the rate of distention and the presence of previous inflammation. The bony cavity itself may be greatly enlarged but this is not usually the case; ordinarily one of the walls gives way before the others show much change. The defect, as a rule, occurs in the normally thin floor of the sinus overlying the orbit, allowing the distending sac to push into the upper medial portion of the orbit and displace the globe. Less frequently, areas in other directions may give way more readily and dural exposures not uncommonly are seen at operation, the floor being still intact. Cranial invasion has occurred and a spontaneous pneumo-ventriculogram from rupture into the ventricles has been described by Armitage.[1]

CLINICAL PICTURE

When cases are seen early, they come in because of headaches, which are variable in location or the cases are found more or less accidentally by chance roentgen observation. The usual clinical picture is that of a slowly progressive, painless swelling in the upper orbit. This may be the only symptom or this entity may be overlooked until the swelling has forced the eyeball forward, down, and laterally to such a degree as to cause diplopia. Occasionally, persistent epiphora is the presenting complaint, so that many of these patients first consult an ophthalmologist. There may or may not be a history of trauma or of previous nasal inflammation.

Physical examination, if external tumor is present, reveals a swelling of the medial one-third of the upper eyelid. The size varies from a barely perceptible mass to a large tumor which displaces the eyeball considerably. The small tumors give the impression of bony hardness. As the distention increases, egg shell crackling may be elicited and, finally, a resilient compressible area, with hard bony margins, is noted. The overlying skin is normal and there is no tenderness to pressure. Vision is normal, except for a possible diplopia; ocular movements may show limitation of upward rotation. The fundi are usually negative but a slight edema may be seen. Intranasal examination may reveal evidences of previous inflammation but usually it is negative. In the rare cases of bilateral frontal mucocele, widening of the bridge of the nose is a striking feature.

ROENTGEN EXAMINATION

The roentgen findings parallel the pathological picture. In early cases, there may be no characteristic findings suggesting the condition. Most cases, however, first come under observation when the process has advanced sufficiently to present findings which are fairly distinctive. These

include variations in density of a positive or negative nature in connection with the sinuses and abnormalities of contour and structure of the walls of the sinuses. The changes depend upon the size, shape, and location of the mucocele and the extent to which it has produced pressure effects in the form of erosion, displacement, or reactionary changes in the surrounding structures.

In those cases without bone erosion, the positive findings are limited to the cases which arise from a retention cyst. A normal sinus contour is present, inside of which is seen a localized shadow of slightly increased density with smooth rounded outlines. The size is variable. The remainder of the sinus shows normal or increased density.

When the distending fluid has begun to cause bone changes, the roentgen findings are quite characteristic. The gross outline is usually slightly larger than that of the other side, and there is decreased density over the sinus. The borders lose their septate or scalloped appearance and the marginal densities become rarefied, smooth, and regular, which is perhaps the most characteristic finding. If the distention is rapid, the border may show roughening and areas of bony deficiency. The orbital roof may be flattened and pushed down and a defect be seen in it. The ethmoidal cells may be encroached upon. A lateral exposure may reveal considerable unsuspected encroachment upon the anterior cranial fossa. If the process is very slow, there may be areas of increased density along the margins or superimposed upon the cavity of the sinus, which represent reactionary bone formation. These shadows may be so dense as to bring up the question of a concomitant osteoma.

DIAGNOSIS AND DIFFERENTIAL DIAGNOSIS

In exceptional cases, the roentgen findings may be sufficiently distinctive to base a probable diagnosis upon them alone. Usually, however, they should be considered in connection with the clinical aspects of the case, when they may constitute the deciding factor in arriving at the ultimate diagnosis. As a rule, changes indicating a decreased radiopacity are of a greater diagnostic value than those of increased density. Although the fluid filled cyst is less radiolucent than the normal air filled sinus, this added density is more than offset by the secondary erosion of the walls caused by the expanding cyst. Increased densities are suggestive of the condition only when accompanied by secondary changes of the surrounding structures or if localized within the sinus, as in the cases of small retention cysts. Lateral as well as sagittal exposures should be made in all suspected cases as they may be of value in ruling out shadows due to anomalous configurations of the sinuses or abnormalities of a tumorous nature. Lipiodol injections may aid in the diagnosis in some cases.

As regards the differential diagnosis, cases presenting mainly rarefying changes reveal roentgen findings similar to those of destructive bone lesions due to osteolytic tumors or inflammatory processes. The former, if malignant, usually produce greater irregularity of outline because they are invasive in character rather than distensive. Metastatic bone lesions or cystic bone tumors, such as myeloma, might conceivably present difficulty in differentiation, but the fact that they are usually multiple should serve to rule them out in most cases. Inflammatory lesions likewise are apt to be more irregular in their extent and may show sequestra. In all of the above conditions, the clinical findings are usually distinctive enough to prevent confusion.

In the presence of increased densities, possible mucoceles may have to be differentiated from osteoblastic malignant tumors and osteomata, as well as from empyema and pyocele. The first are characterized by the usually greater irregularity of contour and multiplicity. Osteomata as a rule give a more dense shadow which is sharply outlined and attached to a localized part of the sinus wall. Empyema shows changes limited within the normal sinus boundaries; if this process is chronic, it

may in time secondarily involve the wall and simulate a mucocele. On the other hand, a mucocele may become infected and in fact become a pyocele. Thus the two conditions may actually be the same or indistinguishable, except on the basis of clinical findings. Smith's[8] and Beyer's[3] cases illustrate this difficulty.

CASE REPORTS

Case 1. H. F., male, aged twenty-three, a concrete worker, entered the Research and Educational Hospitals on April 27, 1933, complaining of prominence of the right frontal region. In 1928, he was struck a blow in this area. In 1931, his parents noticed a prominence on the right side of his forehead which was slowly increasing in size. He had no pain, headaches, dizziness, or diplopia, but he had to hold open the lids of his right eye to see as clearly as with his left.

Physical examination showed a healthy young man, well except for the enlargement of the right frontal region, which extended 8 cm. in length, 5 cm. in width, and 1.5 cm. in elevation. The right eyeball protruded forward and was displaced downward. The ocular movements, pupillary reactions, fundi, visual acuity, and visual fields were normal. The blood, urine, and Wassermann examinations were negative.

Fig. 1. Case 1. Enlarged right frontal sinus with increased radiolucency over it. Dense shadow of hyperostotic bone within it. Roof of right orbit flattened and left frontal sinus encroached upon.

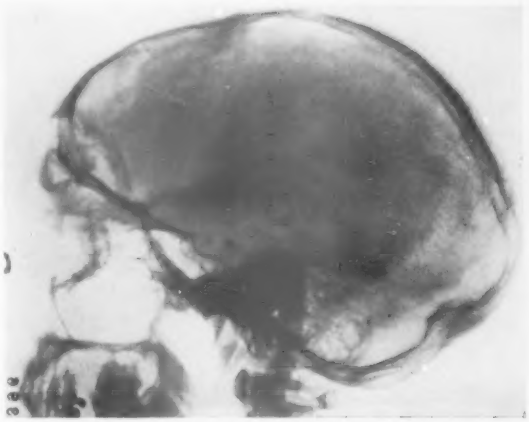

Fig. 2. Case 1. Normal shadow of left frontal sinus visible. Right frontal sinus enlarged, especially posteriorly, encroaching on anterior cranial fossa. Irregular density within it.

Roentgen Report. Films made in postero-anterior, oblique and right lateral directions show a localized rarefaction area above the right orbital ridge with displacement downward of the latter and apparent erosion. Within it there is an irregular dense shadow. The lesion is sharply circumscribed posteriorly and seems to involve the right frontal sinus and part of the left. Diagnosis: Probable mucocele.

On May 6, 1933, Dr. Eric Oldberg entered and curetted a large, thin-walled mucocele cavity. The membrane was thick, yellow and friable. It was filled with a thin amber fluid which pulsated synchronously with the heart beat. The inside of the cavity was irregular with a bony mass projecting into it from the floor. The patient made an uneventful recovery.

Case 11. H. L., female, aged sixteen, presented herself on July 11, 1933, with the following history: Four years ago she noticed a swelling over the left eye. This gradually enlarged until for the past two years it had also involved the left frontal region and the eye began to be displaced downwards and laterally. There were no other symptoms.

Physical examination revealed a healthy girl, normal except for a firm swelling of the upper, inner portion of the left upper eyelid and frontal bone. The left eye was displaced down and out a little. There was no tenderness or palpable defect of the bone. There was a slightly irregular projection of the upper orbital margin, about 4 cm. in length. Fundi, etc., were negative.

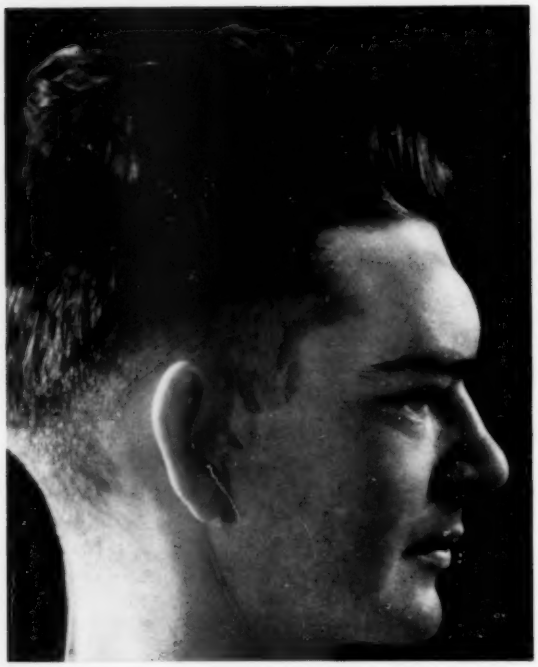

FIG. 3. Case 1. Profile photograph showing prominent enlargement of right supraorbital region.

On August 18, 1933, Dr. Eric Oldberg exenterated a typical mucocele cavity. The walls were intact but the medial septum was gone. The fluid was thin and brownish. The lining was a thick, yellow, friable membrane. The patient made an uneventful recovery.

CASE III. F. R., female, aged twenty-four, entered the Research and Educational Hospitals on April 21, 1925, with the complaint of bulging of the left eye, first noticed about six months after a severe attack of influenza in 1918. It slowly became worse and about one year prior to admission to the hospital vision in that eye began to fail. Headaches developed, especially on the left side, which increased in severity in the preceding four months and at entrance were almost constant. She often felt nauseated but never vomited. The eye was never red nor painful.

Local physical examination showed prominence of the left eye, the bulb standing forward nearly 1 cm., and displaced down and out about 5 mm. An irregular hard ridge was felt projecting forward from the lower edge of the upper orbital margin in its nasal half. It was firm and non-tender. Pupils and tension normal. Right fundus negative, left disc showed slight suggestion of pallor. Visual fields normal. Blood and spinal Wassermann reactions negative. Blood and urine negative.

Roentgen Examination. Films of head made in posteroanterior, lateral and oblique directions revealed a localized tumorous mass with sharp contours posteriorly and above. It extended about 2½ inches in each direction and presented areas of variable density. The orbital roof appeared displaced downward by it. Its probable connection with the frontal sinus was noted. No definite comment of its nature was made but osteochondroma, osteofibroma and meningioma were considered as consistent with the findings.

Operation was deferred and patient left the hospital.

Patient entered Cook County Hospital on June 13, 1925, with practically the same complaints and findings previously noted. On June 29, 1925, Drs. Suker and Livingston exenterated a typical mucocele cavity. The dura was found exposed postero-inferiorly. The membrane was thick and hyperplastic. There

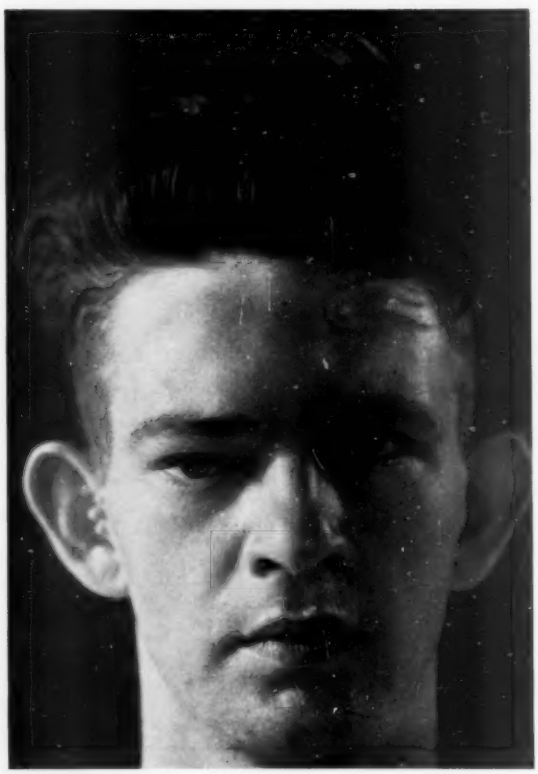

FIG. 4. Case 1. Photograph showing marked downward displacement and slight lateral deviation of right eye with narrowing of palpebral fissure.

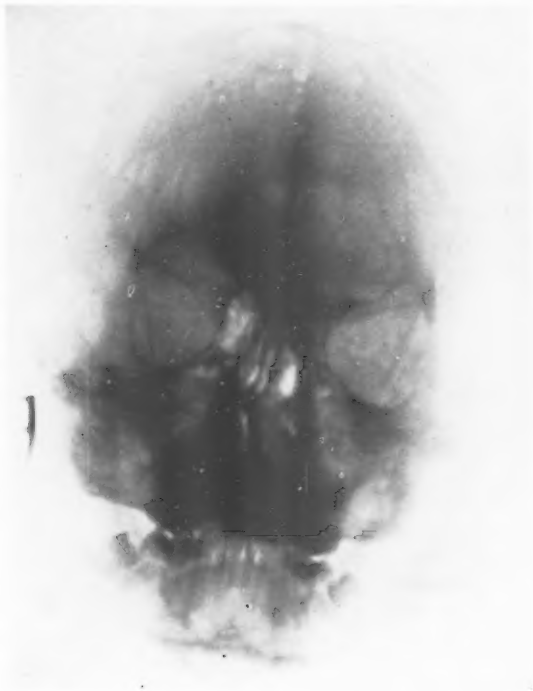

Fig. 5. Case II. Film shows usual enlargement of sinus outline with depression of orbital roof. Marked density along medial and inferior border representing hyperostotic bone.

was slight postoperative sepsis. Patient was discharged on July 25, 1925.

Abstract of pathological description and diagnosis by Dr. C. C. Guy: Specimen is apparently the wall of a cystic structure. One section is composed of fibrous elements in various stages of organization and various degrees of cellularity. In another section, the tissue is composed of osteoid elements supported in a cellular fibrous stroma. The osteoid elements were associated with many osteoblasts but there were no osteoclasts or any multinucleated cells of any type. The fibrous elements showed no evidence of anaplasia. Diagnosis: Osteofibroma ("the histological appearance does not permit an opinion as to whether this is a true neoplasm or is on an inflammatory or traumatic basis").

Case IV. C. B., aged eighty, was referred from the Illinois Eye and Ear Infirmary for films of the head. He complained of poor vision, especially in the right eye, and inability to read of two weeks' duration. About three or four years before, he struck his right eye on the edge of a rolling chair.

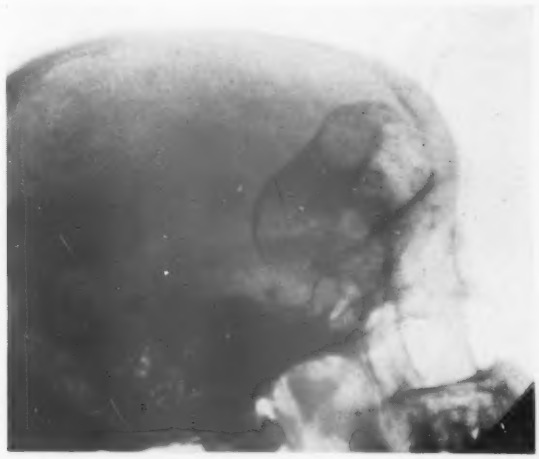

Fig. 6. Case III. Lateral view showing marked encroachment on anterior cranial fossa. The irregular densities represent posterior sinus wall and hyperostotic bone. Note the anterior limit in the orbital region. Frontal views similar to others shown.

Local physical examination revealed that the right eye projected down and out, the right globe being about ¾ to 1 inch lower than the left. Vision in that eye consisted of light perception only. Palpation revealed a solid mass up under the right orbital ridge. Grossly, the ocular tension was increased on the right and

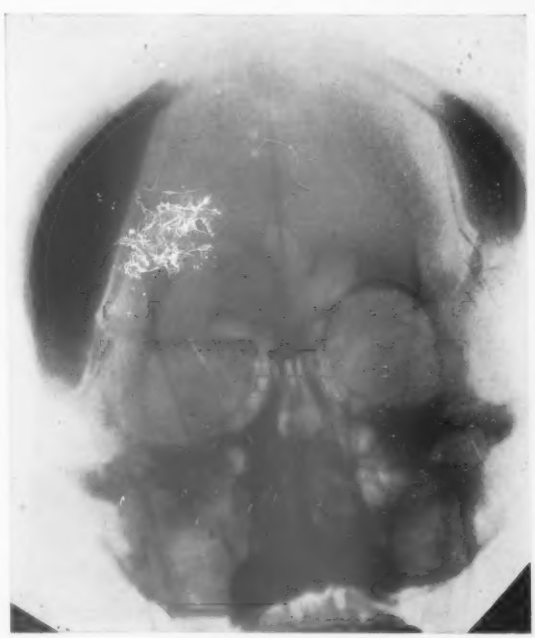

Fig. 7. Case IV. Smooth distention of right frontal sinus walls with flattening of roof of orbit.

normal on the left. Fundus examination showed the right optic nerve hazy as if covered with exudate, suggesting a neuroretinitis.

Roentgen Report. Evidences of right maxillary sinusitis and probable mucocele of right frontal sinus.

Patient never returned to dispensary.

SUMMARY

A mucocele is an accumulation and retention of a mucous secretion within a nasal accessory sinus, usually associated with distention of one or more of its walls. The usual causative factors are obstruction of the nasofrontal duct or enlargement of a retention cyst. It occurs at any age. History of trauma is often elicited. Early symptoms are varied but later findings of a slow-growing, non-tender tumor in the medial third of the upper eye with displacement of the globe forward, downward, and laterally are characteristic.

Roentgen findings in connection with mucocele of the frontal sinus vary according to the stage of development of the condition. The most characteristic findings are enlargement of the sinus with pressure erosion of the walls, resulting in increased radiolucency and displacement of the boundaries causing distortion of outline. Reactionary bone formation may be present.

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CHOLESTEATOMA

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CHOLESTEATOMA, or pearly tumor, is a rare benign squamous epithelial neoplasm usually containing cholesterin crystals. In thirteen years, only 2 cases have come to my attention from a very large number of skulls examined. Several cholesteatomata occurring in the mastoid have been observed. Recently Van Wagenen[4] reported 149 verified brain tumors but found no cases of cholesteatoma.

The genesis of this tumor is not definitely known but it is assumed to be due to congenital epithelial rests with an aberrant function to synthesize cholesterin.

Cholesteatoma occurs chiefly in the pia[1] but has also been found in the brain,[2,5] petrous pyramid,[3] and other cranial bones. They are comparatively frequent in the mastoid process where an almost complete exenteration of the cells may result by the extension of the growth. In view of the presence of a cholesteatoma in a chronically diseased mastoid, the origin of the tumor here may be the result of chronic irritation or an invagination of the epithelial coats of the auditory canal. If this supposition is accepted, the neoplasm may then be classified as primary, when it occurs beyond the boundaries of the mastoid process, and secondary, when its presence is within the mastoid.

Pathology. Grossly, the tumor is, as a rule, described as being irregular in shape, hard and pearly white, hence its synonym. Depending, however, on the stage of its growth, the mass may be found to be soft, friable, yellowish in color and of an amorphous consistency. On sectioning, it presents a loose structural make-up due to the texture of the amorphous composition of the mass.

Microscopically, the tumor is composed of flattened epithelial cells mixed in various proportion with cholesterin crystals. The finding is not constant[1] since it is, at times, difficult to demonstrate the epithelial origin of these growths.

Symptomatology. The growth of a cholesteatoma is very insidious and produces no symptoms until mechanical pressure results by the invasion of the tumor. When it occurs in a diseased mastoid, the aural discharge persists for years.

Diagnosis. The presence of a lesion in the diploë of the skull may not produce any visible or palpable changes. In 2 of my cases, the area involved appeared slightly elevated and irregular in contour. The diagnosis can, as a rule, be made roentgenographically.

Roentgenologically, cholesteatoma is of interest when the lesion involves the cranial bones. The defects produced by this tumor are clear-cut, punched-out areas of decalcification with dense trabeculae separating the destroyed areas. The mass appears somewhat polycystic and fairly well circumscribed. The lesion is invasive and destructive but does not expand the tables of the skull. The extent of the tumor within the cranium cannot be ascertained, in view of the absence of calcium in the invading growth.

Differential Diagnosis. The following pathological processes may closely resemble a primary cholesteatoma in a roentgenogram: metastatic cancer, sarcoma, myeloma, tuberculosis, xanthoma, osteitis fibrosa cystica, giant cell tumor, hemangioma and septic osteitis.

Metastatic cancer, sarcoma and myeloma occur as multiple, small, clear-cut areas of rarefaction in several parts of the skull.

Primary sarcoma of the skull, while also extensively osteolytic, reveals, as a rule, hyperplasia of osteoid tissue in the invading growth.

Tuberculosis causes marked local halisteresis with irregular hazy borders.

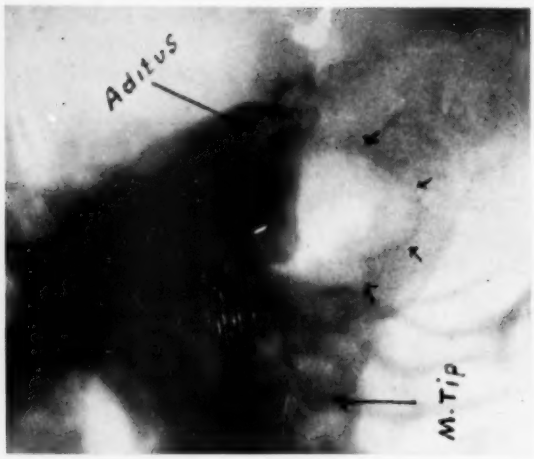

Fig. 1. Chronic mastoid disease of many years' duration with recurrent aural discharge. Mastoidectomy revealed granulations and cholesteatoma (small arrows).

The secondary type of cholesteatoma may have to be differentiated from a resected mastoid, and a mastoid or perisinuous abscess. In either case the history is important. In a mastoid or perisinuous abscess the area of rarefaction is marked in the center and the borders are hazy. In cholesteatoma the rarefied area is definitely circumscribed (Fig. 1).

Fig. 3. Hemangio-endothelioma of frontal bone. Note the startling resemblance to cholesteatoma. Compare with Figure 2.

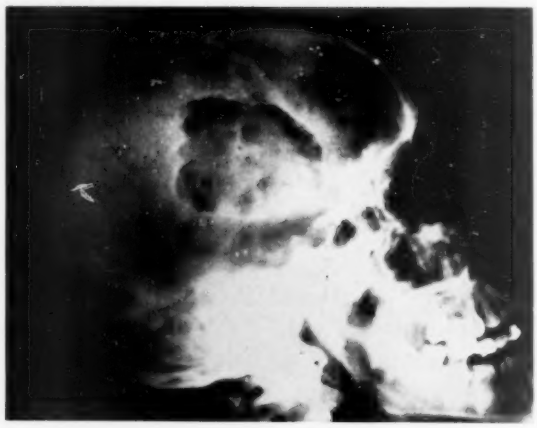

Fig. 2. Case 1. Cholesteatoma.

Xanthoma or Schüller-Christian's disease is characterized by an extensive decalcification without cyst formation. As a rule, the disease involves the parietal and sphenoid bones, causing an exophthalmos.

Osteitis fibrosa cystica and giant cell tumor are expansile growths, more commonly found near a suture. The cortex is invariably preserved.

A hemangioma very closely resembles cholesteatoma and is rather difficult to differentiate roentgenographically. Palpation, however, will readily reveal the differentiation in view of the fact that a blood tumor is a soft, expansile and often pulsating growth as compared with the irregular and resisting mass of the cholesteatoma.

Septic osteitis of the skull is seen as a small irregular area of decalcification with multiple sequestra which appear quite dense.

Case 1. M. D., male, white, aged twenty-eight, admitted to Veterans Hospital No. 81, as a mental case in September, 1924.

Present Illness. In August, 1923, he began to complain of severe headaches, impairment of vision and occasional vertigo. His mentality was slightly sluggish, he appeared less cheerful, hesitated during speech and found difficulty in concentration.

Fig. 4. Case II. Cholesteatoma. Note cyst-like destructive process involving the inner table.

Physical Examination. The skin, head, hair, ears, mouth and chest were normal. Pulse was 84. Blood pressure, 130/90. The knee jerks were exaggerated, more marked on the left. No Babinski; Romberg was present. He walked with a limp, dragging the left leg, the muscles of which appeared slightly atrophic.

Roentgen Examination. The skull revealed a circumscribed area of decalcification in the parietofrontal region measuring 7×5.5 cm. The destroyed area appeared cystic.

The patient was operated on and a cholesteatoma was resected by Dr. J. E. J. King.

Case II. B. M., male, white, aged twenty-six, was admitted to the second Surgical Division at Bellevue Hospital in April, 1934.

Present Illness. Has had moderately severe headaches for one and a half years, worse at night. Straining and bending increased the headache. The pain originated in the left occipital region, extending to the right and over the entire head.

Physical Examination. Palpation of the head revealed a slight irregular bumpy area in the left occipital region, firm and not tender. The only neurological finding of interest was a blurring of both discs.

Roentgen Findings. There was a cystic area of destruction of the left occipital bone extending from the mastoid process to the midline and from the left lateral border of the foramen magnum to a point close to the lambdoid suture above.

Fig. 5. Case II. Anteroposterior view.

The patient was operated on, the left occipital bone was exposed and several cystic areas involving all the tables of the skull were encountered; several ounces of jelly-like substance were removed and the bony recesses curetted. The dura was exposed but was not found to be involved.

Pathologist's Report. The soft, friable, grayish-yellow tissue consisted of an amorphous

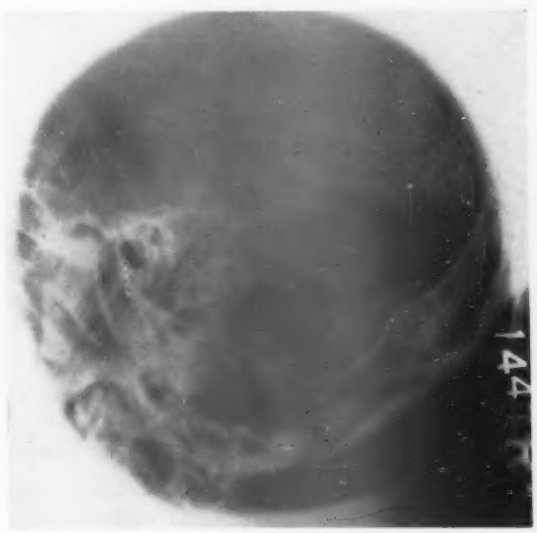

Fig. 6. Case III. Polycystic cholesteatomatous area in retromastoid region and destruction of inner table (arrow). Compare with Figure 4.

acellular material. The capsule was thin, fibrous and lined by atrophic squamous epithelium. No cholesterin crystals could be found.

Case III. L. R., male, white, aged forty, admitted to Bellevue Hospital in May, 1923.

Present Illness. Patient complained of pain in the right side of neck, radiating to the occiput and vertex, for a period of three months. Pain usually began at night, lasting a few hours and then gradually disappeared; this condition recurred once or twice during the day.

Fig. 7. Osteitis fibrosa cystica.

Physical Examination. The scalp, ears, nose and hearing were found to be normal. He was unable to close the right eyelid; the pupils were equal and were active to light and accommodation. The fundi were normal. The tongue was moist, coated and deviated to the right.

Neurological Examination. The patient's mentality was clear. There was a complete paralysis of the right side of the face and palate. He has had some difficulty in swallowing. The taste sense was normal. The reflexes were active and equal. There was atrophy of the right side of the tongue and the sternocleidomastoid muscle. The provisional clinical diagnosis was sarcoma of the skull.

Roentgen Examination. The skull revealed a polycystic area of destruction involving the diploë and inner table of the occipital bone from the posterior margin of the mastoid process, for a distance of 3.5 cm. and extending to the base.

In view of the clinical opinion, radiation therapy was given, but no results were noted. No biopsy could be obtained. The roentgen findings and effects of pressure by invasion of the tumor are definitely consistent with cholesteatoma.

SUMMARY

Three cases of cholesteatoma are presented of which 2 have been verified by the pathologist. Early roentgen diagnosis is practical, in view of the fact that the long-standing tumor simply changes in extent rather than in appearance.

The necessity of physical examination must be stressed, especially in differential diagnosis and to disclose the effects of pressure by invasion.

Radiation therapy, applied to one case, was of no avail. Obviously, surgery is the treatment of choice.

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CLEIDOCRANIAL DYSOSTOSIS*

A CASE REPORT

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THE last six lines of Osler's textbook of medicine are devoted to a rare congenital condition known as cleidocranial dysostosis. Six lines in a twelve hundred page book denote very aptly the relative importance of this syndrome. However, regrettable though it may be, it is just such a rare condition that so frequently attracts our interest because it is unique and bizarre.

HISTORY

As early as 1765 Martin described a clavicular defect which is probably the first case of this condition reported. It was not until 1897 that Pierre Marie and Paul Sainton called this clinical entity "dysostose cleidocranienne héréditaire," emphasizing the increased transverse diameter of the skull with retardation in ossification of the fontanelles, the aplasia of the clavicles, and the hereditary character. Since then more than one hundred papers have appeared in the literature on this subject, the most noteworthy of which are those by Hultdrantz[4] in 1908, Fitzwilliams[3] in 1910, Langmead[7] in 1916, and Fitchet[2] in 1929.

DEVELOPMENT OF SKULL AND CLAVICLES

To appreciate some of the changes which occur in the skull and clavicles in this syndrome one must have some understanding of their development.[1] At an early stage in the development of the fetus the cerebral vesicles are enclosed in a membranous envelope called the primordial membranous cranium which is derived from the mesoderm. In mammals cartilage is developed only in the basal portion of the skull; the roof, the greater part of the lateral walls, and even part of the base remain membranous until bone is formed in them. In the human embryo chondrification of the base of the cranium begins early in the second month of development and has almost attained its maximum by the end of the third month. Some of the bones of the skull are ossified in the cartilage of the base, namely, the occipital bone, except for the portion of its squama above the nuchal line; the petrous and mastoid portions of the temporal bone; the sphenoid, and ethmoid. Some bones are ossified from membrane underlying the mucous lining of the buccopharyngeal cavity, namely, the lower portion of the maxilla, the palatine bones, and the greater part of the pterygoid process.

The frontal, parietal, squamous temporal bone, the upper portion of the occipital squama, and the great wing of the sphenoid are ossified in the membranous brain envelope. The zygomatic bone ossifies in membrane which is continuous with the brain case around the lateral margins of the orbit.

The skull bones can thus be divided into two large classes according to their method of ossification—in cartilage or membrane. In cleidocranial dysostosis it is mostly membranous bone which is involved.

The clavicle is the first bone in the body to begin to ossify, and this occurs in the fifth week of fetal life. More of this will be described later.

HEREDITARY AND FAMILIAL FACTORS

This syndrome may be transmitted by either the father or mother to either the sons or daughters. Fitchet[2] in 1929 reported a series of cases which demonstrate characteristically the familial and hereditary character of this syndrome. In this

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series King in 1899 reported the case of a woman who had an ununited fracture of the right clavicle supposedly caused by an accident in childhood. She had 2 living children born after normal pregnancies who had ununited fractures on the same side and in the same place. The girl never married and had no children. The boy married and had 4 children. Three of the 4 children had clavicular defects which were proved roentgenographically.

The hereditary character of this affection was first pointed out by Gegenbauer in 1864 and confirmed by Marie and Sainton. In a series of eight families collected by Fitzwilliams[3] there were 31 affected individuals. There were 5 mothers and 3 fathers in this group suffering from this condition and they transmitted it directly to 23 children.

Fitchet believes the condition is not necessarily hereditary since many cases have been observed where no members of the immediate or collateral family were affected. He believes that it would simplify our conception of the disease if we called it congenital cleidal dysostosis, either hereditary or non-hereditary, and with or without other anomalies. His point is well taken since many cases show only clavicular defects without skull changes, and even with careful investigation the hereditary factor cannot be proved.

PATHOGENESIS

The defective ossification of the bones of the cranial vault causes the typical skull deformity. In infancy these cases display very large fontanelles, and if the parietal and frontal bones are separated in the midline by wide sutures only one large fontanelle may be present. The anterior fontanelle may not close until late in life and in a case reported by Marie and Sainton the fontanelle was as large as the palm of a hand at the age of forty-seven and in Scheuthauer's case it was still unossified at the age of fifty-six.

The metopic suture separating the frontal bones may be wide open. The superior portion of the occipital bone which is developed in membrane is often lacking. With advancing age the open fontanelles and separated sutures gradually close and become ossified and this is usually complete by the seventh year. Because of the delay in the ossification of the sutures, ossification occurs more rapidly in other bones of the cranial vault and the frontal, parietal, and occipital bosses result.

There have been many theories offered to explain this condition: Jansen[5] suggested a theory which has not been very widely accepted. He believes that a restriction in the growth of the amnion with consequent pressure of the amniotic fluid upon the embryo is the cause of the subsequent deformities. This pressure he presumes occurs in the eighth week of pregnancy when the bones are beginning to develop.

Alcoholism, tuberculosis, syphilis and rickets have all been alleged to be causes of this condition, as they have been presented as etiological factors in every syndrome for which the cause is unknown. Many of the abnormalities seen in cleidocranial dysostosis are, however, also noticed in advanced rickets—prominent bosses, delayed closure of sutures and fontanelles, and poor, irregular dentition.

The position that this condition bears to achondroplasia is interesting—the cleidocranial dysostosis being due to maldevelopment of membranous bone, and achondroplasia to defects in development of cartilaginous bone. Ideas concerning the presence or absence of certain chemical constituents in the embryo causing the cranial and clavicular defects have been mentioned but these all lie in the realm of theory.

Apparently these defects are due to some injury of the embryo very early in development and probably at or before the fifth week when the clavicle begins to ossify but what this injurious factor—toxic or traumatic—actually is, is unknown as it is in so many other hereditary and congenital anomalies. The chromosomes or genes probably get mixed up somewhere

in the course of development. Kelley suggests that cleidocranial dysostosis is an abnormal condition inherited as a dominant Mendelian factor and is a mutation of recent origin.

CLINICAL SIGNS

A. *Skull:* All parts of the cranium participate in the deformity. The head is usually large and brachycephalic, that is, the cephalic index is more than 80, the transverse diameter of the skull being increased.

$$\text{The cephalic index} = \frac{\text{max. breadth} \times 100}{\text{max. length}}.$$

The breadth of the skull is measured at the widest points between the two parietal bones. The length is measured between the nasion and the most posterior occipital point. The cephalic index in these cases is usually above 80.

Various bones in the skull may fail to unite so that the fontanelles remain persistent throughout life. Secondary accessory centers of ossification may appear and rows of Wormian bones may separate various bones. As a result of late closure of the cranial sutures sulci may form in the coronal, lambdoidal, metopic, and sagittal sutures. Grooves are formed along these lines that are easily palpable and the skull is divided into six bosses: frontal, parietal, and occipital on each side. A median furrow extending from the nasion upward to the sagittal suture divides the frontal area into two bosses. This median furrow is the wide metopic suture, greatest in width just above the nasion and narrowing as it extends upward.

B. *Face:* The face appears rather small compared to the large head, and the bones of the face are usually underdeveloped. The bridge of the nose is usually sunken. The nasal and lacrymal bones which are membranous bones may be defective or absent. The zygoma is poorly developed, small, flat, and sunken. The height of the orbit is often large compared to the width. The orbital ridges may overhang the orbits. The roof of the orbit may be depressed and cause mild exophthalmos. The superior maxilla is usually small. The air sinuses are poorly developed or absent.

C. *Palate:* The palate is often high arched and a cleft plate is occasionally present.

D. *Clavicles:* The clavicular defects divide themselves into three classes: (1) complete absence; (2) partial defects usually of the acromial end, and (3) separation of the clavicular fragments with the pseudo-arthrotic gaps filled by connective tissue.

In a survey of 58 cases of this condition, made by Fitzwilliams in 1910 he found both clavicles absent in 6 cases; the left clavicle alone totally absent in 2 cases. The right clavicle was present in some degree in every case. It is the acromial end of the clavicle which is usually either entirely absent or poorly developed when present. The sternal fragment is usually fairly well developed or may be present only as a small cartilaginous nodule. When half of the clavicle is absent it is the acromial portion which is lacking, and usually on both sides. Both halves of the clavicle may be present but united in a pseudo-arthrosis of fibrous tissue and this is also usually bilateral and the sternal fragment is almost always larger.

If the sternal end alone is present a ligamentous prolongation is usually found extending not to the acromion but to the coracoid process. Fitzwilliams enters into a long discussion in his very admirable paper on the development of the shoulder girdle and the clavicles in particular, and presents a very convincing argument that since the membranous bones are affected in this condition and since the acromial end of the clavicle is the portion that is usually not ossified, the acromial end must have arisen in membrane and the inner portion from cartilage and, contrary to the opinion of anatomists, there is a dual and not a single origin for the clavicle.

Because of the clavicular defects the neck appears long, the shoulders narrow and the supraclavicular fossae indistinct. The shoulders droop and assume the position seen in clavicular fractures.

E. *Muscular Variations:* Because of clavicular defects there are necessarily abnormalities in origin and insertion of muscles that are normally attached to the clavicle.

The sternocleidomastoid muscle arises from the anterior surface of the manubrium by a tendinous attachment and by a broader clavicular origin from the medial third of the superior surface of the clavicle. If the clavicle is well formed the muscle is normal. But if the clavicle is absent or if only a small rudiment remains, the clavicular head may be greatly reduced. In spite of the frequent involvement of the sternocleidomastoid muscle no case of torticollis has ever been reported. Function in lateral rotation of the head is usually not affected.

The trapezius arises from the occiput, the ligamentum nuchae and the spines of the cervical and thoracic vertebrae and is inserted as follows: the occipital and upper cervical fibers into the lateral third of the clavicle; the lower cervical and upper thoracic fibers into the medial border of the acromion and the spine of the scapula; the lower thoracic fibers into the spine of the scapula. Since the outer end of the clavicle is usually absent the upper portion of the trapezius has not a point of insertion and is usually poorly developed. The function of the muscle in helping to shrug the shoulders and to brace back the shoulders is as a general rule not affected.

The deltoid muscle which arises from the lateral third of the clavicle, the lateral border of the acromion, and the spine of the scapula may be defective in its anterior fibers but function is not interfered with.

The pectoralis major which arises from the medial half of the clavicle and from the manubrium sterni may also be poorly developed so far as its clavicular origin is concerned.

In spite of all these defects function is usually remarkably good. Most patients can do strenuous work and are unaware of anything abnormal although they may complain of fatigue and weakness. The range of shoulder movements is really remarkable. The illustrations usually picture the patient with his shoulders in apposition in front of the chest under the chin giving the patient a particularly bizarre appearance. With the patient in the resting position the shoulders assume the position typically seen in clavicular fractures, the shoulders are lowered, swung forward and the scapulae appear winged because of the prominent vertebral borders.

F. *Teeth:* The development of the teeth is greatly disturbed. Dentition is late and irregular. There is apt to be prolonged retention of deciduous teeth, faulty alignment, delayed eruption, and enamel defects.

G. *Other Skeletal Deformities:* Numerous skeletal deformities may be found associated with the skull and clavicular defects. The stature of the patient is apt to be small. The upper chest is usually more conical than normal. There may be present deformities in the sternum, cervical ribs, incomplete ossification of sternum and sacrum, defects in the vertebrae, synostosis of cervical vertebrae, spina bifida, pelvic malformations, congenital dislocation of the hip, tibial curvature, genu valgum, coxa vara, pes planus, malformation of the fingers, and incomplete ossification in the carpal and tarsal bones.

H. *Neurologic and Psychiatric Aspects:* Poynton,[9] in 1914, reported a case who complained of shooting pains down the right arm, loss of power of the right hand, and circulatory disturbances. Here the outer fragment of the right clavicle was pressing on the brachial plexus. Surgical removal relieved the symptoms.

Krabbe[6] reported a case in a patient who was apparently a paranoid dementia precox. The patient was always backward mentally. He was admitted to a mental institution because he became disturbed, hallucinated, and suffered from paranoid delusions.

In 1929 Stewart[10] reported the case of a partially demented female who presented all the classical signs of cleidocranial dysostosis. She died at the age of forty-seven

of a mitral and tricuspid stenosis. The brain at autopsy weighed 900 gm. The frontal poles were small, narrow and firm. There was bilateral atrophy of the gyrus cinguli, and the corpus callosum and the left caudate and lenticular nuclei were very small. Microscopic examination of these areas revealed enormous numbers of fibroblastic astrocytes. Stewart believes these changes to be due to the result of inflammation in the second month of intra-uterine life when the clavicles and skull are beginning to ossify and he suggests an inflammatory process as the cause for both changes.

Léri and Trétiakoff[5] in 1923 reported inflammatory and hemorrhagic lesions in the brain of a dysostotic woman who died at the age of thirty-one. A cyst was present in the right occipital pole. Scheuthauer described cavities in the frontal lobe in his case. Isolated cases of syringomyelia, epilepsy, imbecility, and hydrocephalus, and various psychoses have also been reported.

1. *Associated Metabolic Disturbances:* Krabbe[6] considers that the skull and clavicular defects of cleidocranial dysostosis are not isolated signs but part of the general picture of an anomalous make-up. He reported a case with a basal metabolism of plus 37 per cent. One of Marie and Sainton's cases displayed adiposity, and Prochoaska's case had a partial situs inversus.

MEDICOLEGAL ASPECTS

There is an important medicolegal aspect to this syndrome. The clavicular defects may be regarded both clinically and roentgenographically as ununited fractures. Fitchet mentions a man in England who capitalized his deformity and made a very comfortable living by allowing his shoulders to be caught in the closing door of a conveyance and then, with convincing roentgen evidence, collecting for his supposed injury.

TREATMENT

Usually there is no disability, and no discomfort, and no treatment is necessary. However, if a clavicular fragment presses upon the brachial plexus it may cause symptoms suggestive of a cervical rib and the surgical removal of the fragment may be necessary.

CASE REPORT

R. C., a white male, aged fifty-five, and a farmer by occupation, was admitted to St. Elizabeth's Hospital on January 5, 1934. A careful investigation was made into his family history but no definite case of cleidocranial dysostosis was discovered in his family. The patient described his father as "round shouldered, but not as bad as mine." Nothing is known of the paternal grandparents except that the maternal grandmother died of cancer of the breast. The father died of "stomach trouble," the mother of an "ovarian cyst." One of the mother's brothers died in a state hospital at the age of seventy-three, the diagnosis being senile dementia precox. Another of her brothers died "blind and feebleminded." One is now in a state hospital, the diagnosis being dementia precox. The mother's sister has been hospitalized twice for manic depressive psychosis. Her physical examination is reported as negative except for a high palatine arch. Her daughter is considered a moron. In none of these individuals have skeletal abnormalities been reported as judged by their hospital records.

The patient's birth was considered normal. Although his statements are not thought to be entirely reliable, he volunteered the information that his teeth were "all mixed up" as soon as they began to appear and that his second teeth came without his first teeth dropping out. Even at the present time he is still "cutting teeth." Since 1905 he has led a hobo type of existence tramping about the country and rarely working. There is no history of excessive alcoholic indulgence. The patient had the usual childhood diseases including chicken-pox, measles, whooping cough, scarlet fever and diphtheria. He suffered from a mild attack of influenza (?) in 1913. In 1928 his feet became frost bitten and his legs became edematous to the knees. Since that time he has suffered with ulcerations of his feet. He has had irregular periods of dull headaches since 1913 and his hearing has been poor since the same date. In 1915 he had what he called the "Cuban itch" which left patches of his skin depig-

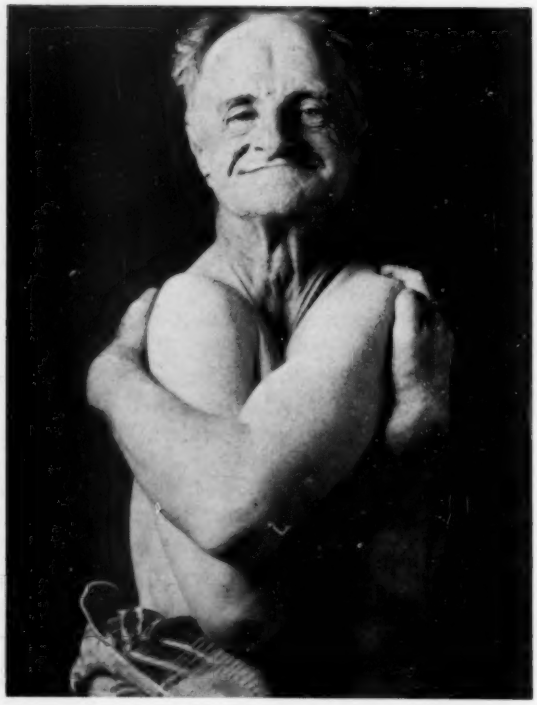

FIG. 1. Note the mobility of the shoulders and the groove in the forehead, representing the wide metopic suture.

mented. He first noticed that his shoulders were different from those of other individuals when he was eighteen years of age. He was able, however, to work on a farm and do heavy labor. The patient has never had any children.

He was admitted to the hospital after having been found by the police sleeping in the road. On admission he was quiet and cooperative but seclusive and he took little interest in his surroundings. The stream of talk was meager but coherent and relevant usually, although his words often ended in a mumble. Apathy and lack of interest characterized his attitude. He admitted auditory hallucinations which he thought might come from a wireless owned by the Salvation Army. Vague unsystematized paranoid delusions concerning the Catholics were also expressed. Attention and comprehension were poor. He was disoriented, memory defective; he had no insight into his condition and his judgment was impaired. He scored eight years eleven months in the Stanford-Binet test, his basal year being six and his reactions quite scattered.

Physical Examination. The circumference of the skull is 56 cm. The fontanelles are closed. There is a broad groove in the area of the metopic suture extending from the nasion and narrowing to the bregma, and extending posteriorly as a narrow groove along the line of the sagittal suture. A groove along the coronal suture separates the frontal bosses from the marked parietal bosses and a groove along the lambdoidal suture separates the parietal from the less marked occipital bosses. The anterior portion of both temporal squamae are unusually thick. The eyes are moderately sunken with overhanging but not excessive supraorbital ridges. The zygomatic bones are small, flat and sunken. The regions of the sutures between the malar bones and the upper jaw are separated by about 1 cm. The nasal bones are deficient in their anterior portions. The maxilla is small compared to the prognathous mandible.

The acromial portions of the clavicles cannot be felt. The sternal fragments measure about 6 cm. and these are palpated as narrow pyramidal pieces of hard tissue, the apex of the pyramid pointing laterally. An indefinite ligamentous prolongation is felt extending from the sternal fragments.

The clavicular head of the sternocleidomastoid muscle is reduced in size. The trapezius is fairly well developed. Movements of the head and shoulders are well performed. The anterior portion of the deltoid muscle is diminished in size, but function is good. The clavicular portion of the pectoralis major is reduced in volume. The shoulders are lowered and swing forward slightly. The two shoulders

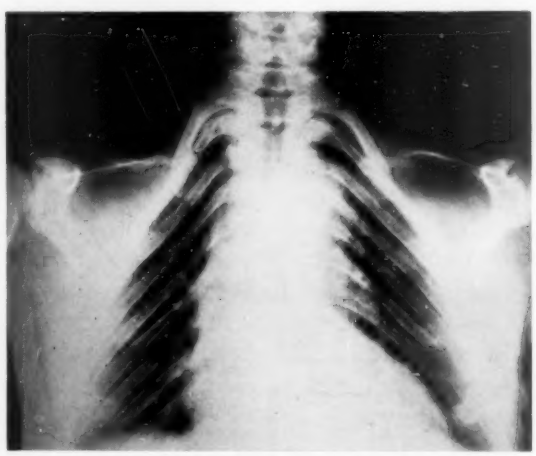

FIG. 2. The rudimentary sternal fragment of the left clavicle is easily visible, that on the right is indefinite.

can be approximated in front of the body to within 4 cm. of each other.

The teeth are in very poor condition. Many are carious and several snags are present. They are irregularly placed and shaped and all are misaligned. The lateral incisor in the left upper jaw and the canine in the right upper jaw are just breaking through the gums and the patient states that these are his "second" teeth just beginning to appear. The hard palate is narrow and high.

The suprasternal fossae are indistinct, blending with the anterior surface of the chest which is barrel-shaped and comparatively narrow in its superior and inferior portions. The xiphoid process of the sternum is absent. The ridge at the sternomanubrial junction is indistinct. There is a moderate lordosis of the lower dorsal and lumbar spine with a slight scoliosis to the left.

Both trochanters are above Nélaton's line. The left trochanter is about 3 cm. higher than the right and the left femur is about 3 cm. shorter than the right. There is a shallow, clean-cut ulcer on the medial aspect of the right foot at the base of the big toe. The distal phalanges of several toes are missing and the nail beds of those remaining show trophic changes. The joints of the left big toe are fixed. Both feet are moderately cyanotic and the dorsalis pedis pulse cannot be felt, although the posterior tibial pulse is strong. The capsule of the right knee is loose, permitting some lateral movements and some hyperextensibility.

Fig. 3. Note the thickening of bone in the parietotemporal region.

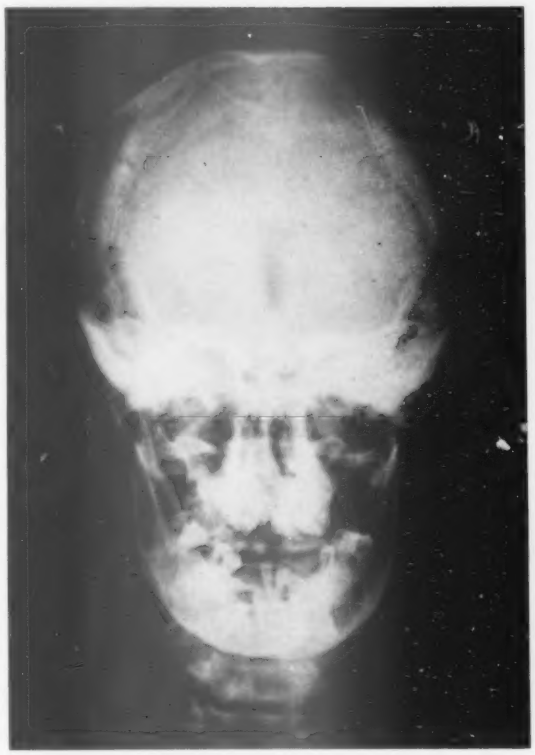

Fig. 4. Note the wide metopic suture. The unerupted and misaligned teeth are very evident.

The heart and lungs show no abnormalities. There is no evidence of peripheral arteriosclerosis. Blood pressure 135/94.

Except for some atrophy of the right thenar eminence neurologic examination was essentially negative. The patient believes that this came on about 1928 when he injured his right hand by a blow.

Laboratory Reactions. The urine analysis is essentially negative. Blood count: hemoglobin 74 per cent; red blood cells 3,800,000 per c. mm.; leucocytes 7,200 per c. mm.; polymorphonuclears 49 per cent; lymphocytes 51 per cent; coagulation time 2 minutes. Spinal fluid: Kolmer negative, protein content 2 plus, 4 cells per c. mm.; 18 mm. mercury pressure; gold curve 012310000. Blood Kolmer and Kahn tests negative. Blood chemistry: non-protein nitrogen, 24.8 mg. per 100 c.c. blood; sugar 86.9 mg. per 100 c.c. blood; phosphorus 2.9 mg. per 100 c.c. blood; calcium 10.5 mg. per 100 c.c. blood. Basal metabolism minus 7.2 per cent. An electrocardiogram showed no abnormalities.

Roentgen Examination. Skull: The cephalic index is 80. The fontanelles are closed. There

FIG. 5. The trochanters are enlarged. The neck of each femur is shortened. On the left the trochanter is higher than on the right.

are secondary areas of ossification, so-called Wormian bones, lying in the occipitoparietal sutures. There is considerable non-ossification of the sutures in view of the age of the patient. There is a U-shaped defect in the occipital bone bordering the foramen magnum and causing a deep indentation of this foramen. The bones of the parietotemporal region are markedly thickened, so much so that the internal structures are effaced in the shadow. All but a few of the mastoid cells on each side are entirely obliterated. The sella turcica is not clearly visualized because of the hyperostosis of the parietotemporal bones. The frontal bones are separated by a wide metopic suture. The nasal bones are entirely absent and the vomer is only rudimentary. There are no styloid processes visualized. The frontal sinuses are bipartite and relatively small. The ethmoids are small. The antra are normal in size but cloudy, especially on the right. The sphenoidal sinus was not visualized.

There is an indefinite shadow about 6 cm. in length on each side of the manubrium sterni. These may represent cartilaginous sternal fragments of clavicles. There are no cervical ribs. There is a small bony projection on the end of each acromion which may represent the fused end of a rudimentary acromial fragment of the clavicle.

There is no spina bifida, synostoses of vertebrae, or defects in vertebral lamina. The pelvic bones show no malformation. The neck of each femur is apparently absent. The trochanters are considerably enlarged and on the left the trochanter reaches the point of impact against the ilium. The nature of this deformity is not clear. It has not the appearance of a coxa vara and it resembles closely the picture of an old neglected fracture of the femur. The tibia, fibula, humerus, and radius on each side showed no abnormalities. In both feet there is a deformity and ankylosis of the first metatarsophalangeal joint with obliteration of the joint space between the proximal and distal phalanges of the great toe. In the third, fourth, and fifth toes of both feet there is only one phalanx. In the second toe there are only two phalanges. No calcification of the arteries in the feet or legs is seen. There are no bony abnormalities of the hands.

COMMENT

So far as can be learned no one in this patient's family is suffering from a condition similar to his own so that probably the familial factor can be excluded in this case. The abnormalities are limited to the skeletal and muscular system. Although a definite history cannot be elicited the de-

FIG. 6. Note the U-shaped defect in the occipital bone bordering the foramen magnum. The Wormian bones are easily seen.

formities are undoubtedly congenital. It is remarkable that function of the shoulder joint is so little interfered with by the clavicular aplasia and concomitant muscular deformities. Fitzwilliams' theory that only membranous bone is involved in this condition is not entirely valid. Here the U-shaped defect in the occipital bone occurred in the portion derived from cartilaginous bone. The abnormalities in the femur are very probably congenital anomalies. The primary center of ossification of the body and neck of the femur appears in the seventh week of fetal life when the cause for the skull and clavicular defects supposedly occurs. The disturbances in the feet are probably not directly related to the cleidocranial dysostosis but are considered as a superimposed complication. How much of this patient's intellectual defect is due to deterioration and how much to original mental deficiency is difficult to determine, but probably he is at best a borderline mental defective. However, the presence of a congenital or inflammatory condition in the brain could not be found on clinical examination. The atrophy of the right thenar eminence is probably due to local trauma rather than pressure from a cervical rib or acromial clavicular fragment on the brachial plexus.

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A CASE OF TUBERCULOSIS OF THE HUMERAL DIAPHYSIS AND THE CRANIAL VAULT

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THE following case seems worthy of reporting because it demonstrates the coexistence of two uncommon sites of tuberculosis: that of the diaphysis of a long bone and also of the flat bones of the skull. The cases of tuberculosis of the shaft of long bones reported in the literature are rare; Corcoran[1] describes one found in the left femur of a ten year old girl; Van Alstyne and Gowen[9] report a case involving the left radius and both humeri in a three year old male; Schwentker's[7] case involved both ulnae and the left tibia in a one year old male infant; and Sanes and Smith[6] describe the case of a fifty-six year old female in whom the condition was found in the distal portion of the right fibula and left tibia.

In addition, Meyerding and Mroz[4] reported several cases of tuberculosis of the greater trochanter, at least 3 of which were probably cases of osteitis tuberculosa multiplex cystica, although they did not classify them as such. Milgram[5] reviewed a series of 142 cases of tuberculosis of the bone, joint and bursa which had been examined in the pathology laboratories of the University of Iowa and found 10 of them to be tuberculosis of the diaphyses of long bones. Before the reporting of these cases osteitis tuberculosa multiplex cystica was thought to be confined to the bones of the hands and feet as reported by Jüngling[2,3] in 1920 and in 1928.

Tuberculosis of the flat bones of the skull is uncommon but not rare as Straus[8] points out in his review of the literature where he found 220 cases; he added 3 of his own. Actually it is probable that neither condition is as uncommon as the few cases reported might indicate, since all of the above cases of osteitis tuberculosa multiplex cystica in long bones have been reported within the last three years, and Weiting and Raif Effendi[10] report having seen 10 cases of tuberculosis of the flat bones of the skull in a single year. However, I have found no case in the literature combining these two unusual sites.

REPORT OF A CASE

A. B., a colored male child, aged five, was admitted to Undercliff January 10, 1931.

Family History. Parents and 4 siblings reported alive and in good health, none dead, and no known contact with tuberculosis.

Past History. Parotitis at the age of one year, pertussis and morbilli at the age of two years.

Present Illness. Late in July, 1930, he was reported to have fallen and suffered a contusion over his right temporal region; he was taken to the hospital in his home city (Hartford) where a roentgen examination of the skull was negative. He was kept at the hospital, however, where a fluctuant tumor developed at the site of injury and it became larger, although it was not tender or erythematous. This tumor was incised and sterile pus obtained although it continued to drain. Similar tumors soon developed elsewhere on his scalp and one over his manubrium; this last was incised and a sinus through the manubrium discovered. Acid-fast organisms typical of tubercle bacilli were found in this pus on direct examination and on January 10, 1931, he was transferred to Undercliff Sanatorium.

Physical Examination. On admission draining sinuses were found over the right temporal region, the right parietal region, the left frontal sinus, over the left zygoma near the orbit, and over the manubrium. The balance of his physical examination was essentially normal. He showed a reaction to 0.1 mg. of old tuberculin intradermally. Smears of his various draining sinuses showed no acid-fast bacilli. Stereoscopic roentgenorgrams of his chest showed a large mass of left hilar lymph nodes and the shadow of a primary tuberculous infection which had

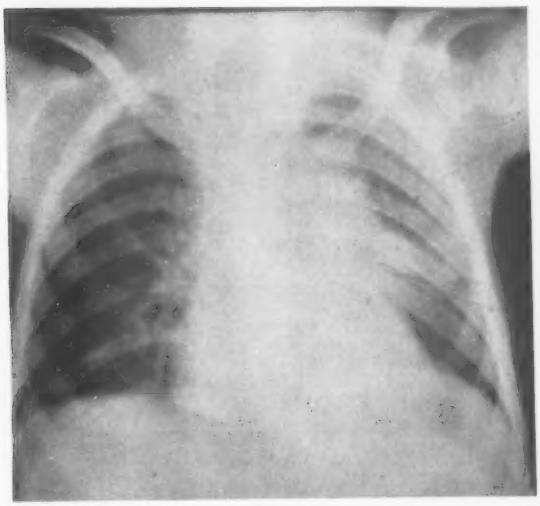

Fig. 1. Roentgenogram of the chest taken January 12, 1931, showing remnant of primary tuberculous lesion in the left lung, and glandular enlargement in the left hilus. Patient is somewhat rotated.

started to regress (Fig. 1). The Wassermann and Kahn reactions were negative, as were other laboratory examinations.

On January 15, 1931, a non-painful, non-erythematous, fluctuant tumor appeared over the first left metatarsophalangeal joint and a roentgenogram of the left foot taken February 4, 1931, showed rarefaction of the first metatarsal bone. On March 19, 1931, this abscess was aspirated and the pus showed acid-fast rods by direct smear, and growth on Petroff's medium was typical of tubercle bacilli. Drainage from other sinuses continued and this last site soon broke down and drained.

A roentgenogram of the chest taken August 5, 1931, showed the parenchymal shadow to be largely resorbed and the hilar mass to be smaller and containing early calcific deposits. Drainage from the foot sinus ceased spontaneously in October, 1931, and that from the sternal and scalp sinuses had decreased markedly.

In January, 1932, it was noticed that the patient carried himself in a manner suggesting a spasm of his deep back muscles and on examination a small knuckle was found in the region of the 5th lumbar vertebra. A roentgen examination of this area revealed a tuberculous erosion of the body of the 5th lumbar vertebra with involvement of the discs on either side of it (Fig. 2). He was immobilized on a Bradford frame until June, 1933, when a Hibbs

Fig. 2. Lateral roentgenogram of the spine taken January 26, 1932, showing tuberculous erosion of the 5th lumbar vertebra.

Fig. 3. Anteroposterior and lateral roentgenograms of the right humerus taken April 4, 1934, showing tuberculous involvement of the diaphysis.

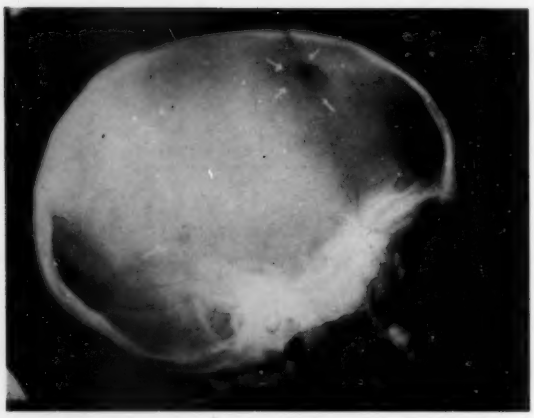

Fig. 4. Lateral roentgenogram of the skull, showing tuberculous involvement of three areas. Taken April 6, 1934.

spinal fixation was done (Dr. R. G. Urquhart). In April, 1934, a hard non-painful, non-erythematous tumor was noted over the right humerus; it apparently had a bony attachment, and a roentgenogram taken April 4, 1934, revealed a spindle-shaped enlargement of the humerus at the junction of the distal and middle thirds with a slight thinning of the cortex (Fig. 3). Roentgenograms of the skull taken April 6, 1934, showed areas of rarefaction at the sites of the various sinuses (Fig. 4). On April 6, 1934, the Wassermann and Kahn reactions were again negative.

The child has been treated expectantly with the exception of the Hibbs' fixation, following which he was returned to the Bradford frame. The majority of his sinuses have closed spontaneously and the humeral lesion is so recent that no definite course of surgical treatment has been planned.

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Vol. 34, No. 1

ADENOCARCINOMA OF THE ORAL CAVITY*

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THESE interesting and uncommon intraoral tumors have in the past received but little attention in the literature and, so far as I have been able to determine, no sizable group of histologically proved cases followed for an adequate period of time has as yet been reported. Nevertheless, these tumors form a definite group with typical pathological and clinical characteristics which entitle them to a separate classification among the intraoral neoplasms. It is the purpose of this report to describe briefly the pathology and in some detail the clinical course of 41 cases of intraoral adenocarcinoma admitted to Memorial Hospital in the past fifteen years.

As early as 1853 Velpeau[1] reported on the gross appearance of these tumors, and in 1866 Stephen Paget[2] was able to collect 31 cases from the existing literature and, although the microscopic pathology was somewhat sketchy, the gross descriptions were most adequate. He was probably the first observer to point out the striking resemblance these growths occasionally bear to tumors derived from the parotid salivary gland.

During the intervening years a great many different pathological terms were applied to these tumors, which resulted in considerable confusion regarding them. Prominent among these terms have been such designations as mixed tumor, adenoepithelioma, adenocancer (1895, Béco[3]), sarcoma, cylindroma, fibro-adenoma, epithelioma, aberrant adenoid cystic epithelioma, and adenoid cystic epithelioma of salivary gland origin. The wide differences in terminology which have been used to describe these tumors in the past make it apparent that cell metaplasia considerably changes the histological characteristics of the tumor during the course of its development. For this reason it is important that stress be placed on the gross character and clinical course of the lesion in making a diagnosis.

Some controversy in the past developed among pathologists as to the origin of these tumors. Paget, noting that these growths showed a predilection for the hard and soft palate, an anatomical region very apt to show arrest or perversion of development, considered that Cohnheim's embryonic theory might be applicable. Morton[4] pointed out their resemblance to tumors derived from the parotid gland and thought this proved their embryonic origin. MacCarty[5] disagreed with the embryonic theory and stated that the tumors were developed from the germinative layer of the palate epithelium, the basal layer of cells developing either into squamous cells or differentiating into glandular cells.

Scattered throughout the submucosa of the entire oral cavity there are numerous saliva secreting glands, large groups being found in the submucosa of the hard and soft palate, mucosa of cheek, and base of tongue. Although adenocarcinoma may occur anywhere in the oral cavity, it is significant that of the cases under consideration, 78 per cent of the primary tumors occurred at sites where these minor salivary glands are most numerous. In the present series of cases the right side of both hard and soft palate is more often affected (Table 1). Past reports give the left side as the most frequent site. The best opinion at this time holds that most intraoral adenocancers are derived from these intraoral minor salivary glands, but may arise in a small number of instances from mucous glands and from aberrant lingual thyroid tissue (Ewing[7]).

Dr. F. W. Stewart makes the following

* Read at the Nineteenth Annual Meeting, American Radium Society, Cleveland, Ohio, June 11–12, 1934.

TABLE I
PRIMARY TUMOR SITES

Location		No. Cases	Percentage
1. Hard palate	Right side	6	14.6
	Left side	2	4.9
	Right and left sides	3	7.3
	Not stated	1	2.4
2. Soft palate	Right side	3	7.3
	Not stated	1	2.4
3. Hard and soft palate	Right side	2	4.9
	Left side	2	4.9
4. Base of tongue		7	17.0
5. Mucosa of cheek		5	12.2
6. Alveolar ridge	Upper	2	4.9
	Lower	1	2.4
7. Floor of mouth		2	4.9
8. Tonsil		1	2.4
9. Nasopharynx		1	2.4
10. Mucosa of upper lip		1	2.4
11. Pharyngeal wall		1	2.4

The above summary shows that intraoral adenocarcinomata develop, as a rule, in locations where large groups of the minor salivary glands are found; 49 per cent of the present series occurred in the hard or soft palate, 17 per cent at the base of the tongue, and 12 per cent in the mucosa of cheek.

remarks after examining the biopsy slides of this entire group of cases:

After reviewing sections from a large number of these glandular tumors of the oral cavity it becomes quite apparent that classification of them into hard and fast groups is impossible. The Memorial Hospital cases of adenocarcinoma seem to comprise at least three varieties, two of which are represented by only one case each, the third making up the balance of the series. One tumor was clearly a tumor of mucous glands (Fig. 6), an adenoma malignum which without knowing its origin might have been mistaken for a gastro-intestinal or rectal carcinoma. One showed a structure consistent in every way with the low grade papillary adenocarcinomas of the thyroid (Fig. 7). This tumor was situated at the base of the tongue and was considered of lingual thyroid origin (Fig. 3). In support of this derivation one has the fact that it behaved so far as its radiosensitivity was concerned like the low grade papillary adenocarcinomas of the thyroid.

All the rest of the tumors appeared to be derivatives of the minor salivary glands or of surface epithelium and ducts differentiating in the glandular direction. Very few showed a definite tendency to differentiate in the direction of the so-called mixed tumors. Slight tendencies in this direction were apparent in a number of cases, but were a minor part of the picture and scarcely justified placing the lesion in the class of mixed tumors. The great majority of the tumors exhibited a very uniform structure resembling the adenoid basal cell tumors of the skin or the adenoid cystic epitheliomas of the major salivary glands. It is our belief that it is desirable to avoid such terminol ogy as basal cell epithelioma or adenoid cystic epithelioma in this group of tumors and to call them all adenocarcinomas of salivary gland origin. The use of the term basal cell epithelioma or adenoid cystic epithelioma tends to convey a false sense of benignity. Furthermore, as has already been stated there is a gradual transition between these tumors and the mixed tumors which make definite classification impossible. True epidermoid carcinomas such as those originating occasionally from ducts or major salivary glands have not been encountered in this group. Neither has there been found the counterpart of the usual malignant alveolar carcinoma often seen in the submaxillary gland and more rarely in the parotid.

In this series of 41 cases there were 21 females and 20 males. The youngest patient was eighteen years of age and the oldest was eighty-five. The average age of the 40 cases in which it was recorded was 49.7 years. The average of the males was 52.1 years, and the average age of the females was 47.5 years (Table II).

A history of a slowly growing, painless lump present in the oral cavity usually for a period of years is a help in making the diagnosis, but it must also be noted that these tumors may take on active, rapid growth at any period of their development.

Fig. 1. C. G. Typical adenocarcinoma of the palate before and after treatment by interstitial radium.

Fig. 2. L. J. Typical adenocarcinoma of the oral cavity developing on the right upper alveolar ridge.

In our series the mouth lesion had been noted for a period varying from six weeks to thirty-five years before the patient applied for treatment at Memorial Hospital. The average duration of the tumor before admission was 4.07 years. Previous treatment had been received by 21 of the patients, in 13 instances surgery had been done, 6 cases had received indifferent radiation therapy, while one received dental care and another had been given mouth washes.

Table II

AGE IN DECADES

No. Cases	Age Groups	Per Cent
1	18 yrs.	2.6
2	26–35	5.1
17	36–45	43.6
7	46–55	17.9
4	56–65	10.3
8	66–75	20.5
1	76–85	2.6

Twenty-four cases, or 61 per cent of the total, were in the age group between thirty-six and fifty-five years on admission to the hospital.

I know of no better clue to a correct diagnosis than is presented by the gross appearance of these tumors. They are oval or round in shape, with their longest dimension running from before backward and their average size is about 3×2 cm. The mass may be slightly lobulated, but is usually smooth, with an adherent, slightly thickened, intact, overlying mucous membrane. The covering epithelium, however, may be somewhat thinned out with prominent capillaries running superficially through it. Ulceration of the mucous membrane may occur and, if it does, usually appears first at the apex of the mound-like swelling. If there has been no previous surgical interference, this ulceration is always due to pressure necrosis from tumor growth. Ulceration was present in 17 cases, absent in 16 cases, and not stated and probably not present in 8 cases of the present series.

Fig. 3. M. Y. Patient aged eighty-three with a large papillary adenocarcinoma of lingual thyroid origin filling the pharynx and causing marked difficulty in eating and talking. Treated by excision and implantation of gold filtered radon seeds in the base.

On palpation these growths are firmly elastic, but occasionally a sense of fluctuation may be elicited, leading the local physician to attempt an incision and drainage. Deep fixation to underlying structures is the rule. The palate lesions are apt to be of a pale, shiny, reddish-yellow color while those arising at the base of the tongue are more likely to present a deeper reddish granular appearance. Encapsulation is often more apparent than real.

The microscopical picture may not be as uniformly consistent as is the gross appearance and therefore the latter should be given more consideration in making the diagnosis. Nevertheless, an aspiration biopsy or perhaps better a surgical biopsy, if one is prepared to institute immediate treatment on receipt of the report, should be done in each case, and suitable roentgen studies carried out to determine the presence of bone invasion and lung or bone metastases, since distant metastases are unfortunately only too common.

A study of Table III shows that the longer these patients are followed the higher is the incidence of local recurrence

Table III

TWENTY-FOUR LIVING PATIENTS WITH COMPLETE DATA

Follow-up Period	No. of Cases	Cases without Recurrence	Cases with Recurrence
From 1 to 3 yr.	9	7 (77%)	2 (23%)
From 3 to 5 yr.	10	6 (60%)	4 (40%)
From 5 to 10 yr.	0	0	0
From 10 yr. up	5	1 (20%)	4 (80%)
Total	24	14 (58%)	10 (42%)

This table shows the significant fact that recurrences of the primary tumor are very apt to develop five years or more after treatment. Only 1 of 5 cases followed more than ten years did not have a recurrence.

of their disease. Of the 5 cases living and followed more than ten years 4 (80 per cent) have shown one or more recurrences. Of the 41 cases in this series, 20 have shown local recurrences, and of these, 10 are living, 7 are dead, and 3 lost to follow-up. In the 20 cases developing recurrent local disease, there were a total of 52 recurrences, or an average of 2.5 per patient.

reasonable to expect the percentage will be still higher when the entire series has been traced for a period of ten years. In 5 of the cases (50 per cent of those showing metastases), the mode of dissemination was undoubtedly by way of the blood stream to lungs, bone, and pleura. In the other 5 cases the lymph nodes in the local drainage areas were affected (Table IV). In a case

FIG. 4. C. K. Adenocarcinoma of the right hard palate and alveolar ridge. Treated by external irradiation, interstitial radon seeds and cautery excision.

Although it may not always be possible to distinguish clinically between local invasion of bone by tumor and localized osteomyelitis and a combination of the two, it has been definitely shown in this series that adjacent bony structures were invaded in 13 cases, or 31.7 per cent of the total (Table IV). The superior maxilla was most often the seat of extension of tumor to bone.

Distant metastasis occurred in 10 cases, or 25 per cent of the total, and it seems

coming to autopsy reported here in detail, the patient died of generalized metastases ten years after first receiving treatment and eighteen years after the onset of symptoms.

The average length of life was studied in 10 cases dying of disease and found to be seven years from onset of symptoms and 3.8 years from admission to the clinic.

CASE REPORT

J. W., female, aged thirty-seven, born in Finland, was admitted to Memorial Hospital

TABLE IV

EXTENSION OF DISEASE

Location of Primary Growth	Bone Invasion	Metastases	Duration of Life from Onset of Symptoms
Hard palate	Antrum and maxilla	Lungs	10 years
Hard palate	Antrum	Submaxillary lymph nodes	
Soft and hard palate	Antrum	Lungs	9 years
Hard palate	Maxilla	Lungs and dorsal vertebrae	6 years
Lower alveolar ridge	Inferior maxilla	—	—
Upper alveolar ridge	Maxilla	—	—
Soft palate	—	Lungs, parietal, visceral pleura	18 years
Hard palate	Maxilla	—	—
Mucosa of cheek	Inferior maxilla	—	—
Base of tongue	—	Bilateral submaxillary nodes	3½ years
Hard palate	Antrum	—	—
Hard palate	Antrum	—	—
Nasopharynx	Antrum and orbit	—	—
Base of tongue		Submaxillary nodes	12 years
Soft palate	—	Submaxillary nodes	Active 12 years
Base of tongue	—	Submaxillary node	1 year
Upper alveolar ridge	Antrum	—	—
Hard and soft palate	Maxilla, antrum and infraorbital plate	—	—
Mucosa of cheek	—	Ribs and pleura	Active 12 years

Ten of the cases developed metastases and 13 of the tumors invaded adjacent bony structures.

Clinic December 14, 1923. Eight years prior to admission she had noted a lump about the size of a pinhead on the soft palate. The lesion caused occasional neuralgia-like pain and gradually increased in size until much of the mouth was occupied by the growth. One year before admission to the clinic the growth had been removed but recurred promptly.

Examination on admission showed a white female of thirty-seven years in good general condition. On oral examination there was an irregular linear scar on the right soft palate 2×3.5 cm. At the upper angle of the scar, just above the base of the uvula, there was a nodule 0.5 cm. in diameter. It was grayish in color, firm in consistence, apparently cystic, and on palpation along the scar a few smaller nodules could be felt.

A biopsy specimen was taken and reported: "adenocarcinoma, salivary gland type."

Treatment was started immediately. Three glass radium emanation tubes for a total of 2.9 mc. were inserted into the lesion in the soft palate on December 14, 1923. Three more glass radium emanation tubes for a total of 2.4 mc. were inserted into the same area February 6, 1924. The response to irradiation was unsatisfactory. On March 4, 1924, eight glass radium emanation tubes were inserted into the soft palate lesion. Following this there was satisfactory radiation reaction and for one year there was no definite evidence of disease.

On July 3, 1925, a small indurated area about the size of a pea was noted in the soft palate. Two gold filtered radon tubes for a total of 2.92 mc. were inserted into this area July 30, 1925. There was complete regression of disease. Perforation of the soft palate resulted, but the patient remained free of disease during the following four and one-half years.

Several pulmonary hemorrhages occurred during 1930 and chest films revealed evidence of metastatic deposits in the right lung. Between May 28, 1930, and June 11, 1930, she was given high voltage roentgen therapy to the right lung and her general condition improved.

Roentgenograms of the chest taken September 4, 1931, revealed an extension of the metastatic process in the right lung and beginning involvement of the left. During the next two years she was followed in the clinic and no local recurrence of disease was noted. However, her pulmonary condition became more troublesome and she was admitted to Booth Memorial Hospital where she died March 13, 1933. An autopsy was performed and the following is a summary of the findings: "Anatomical diagnosis: adenocarcinoma of the soft palate; extensive parietal and visceral pleural metastases; gangrene lower lobe left lung; generalized subcutaneous edema; myoma uteri; ascites. Microscopical findings: adenocarcinoma of salivary gland origin; extensive widespread central necrosis of liver which in places must be classed as an acute yellow atrophy."

In discussing treatment and reporting results we will consider in this study only those cases which have been carried along for five years or more. There are 8 patients living and well at least five years and of these there were 4 who did not have a local recurrence of their disease. The treatment carried out in each of these 8 cases is given in detail in Table v. Two cases were treated only by surgical excision; in each case, although the tumor was fairly large, it was nevertheless thoroughly encapsulated and was completely removed and did not recur.

Although our treatment may vary considerably with the individual case, still the routine practice at the present time is to treat these cases with an adequate preliminary course of external irradiation by means of divided doses of roentgen rays and then implant a large dose of interstitial radium in the form of gold filtered radon seeds and finally to widely excise the entire tumor mass with the actual cautery.

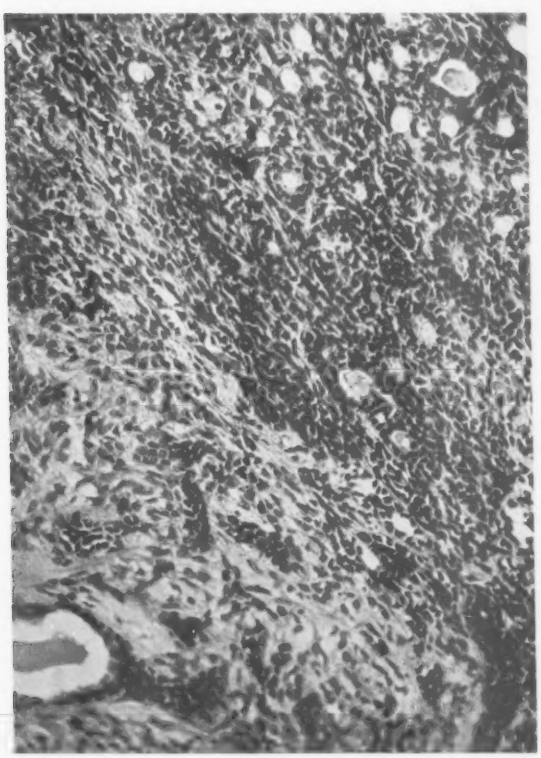

Fig. 5. E. S. Salivary gland adenocarcinoma. Small columns of hyperchromatic cells arranged in solid strands and forming glandular cavities filled with pink-staining hyaline secretion. Supporting structure hyaline connective tissue.

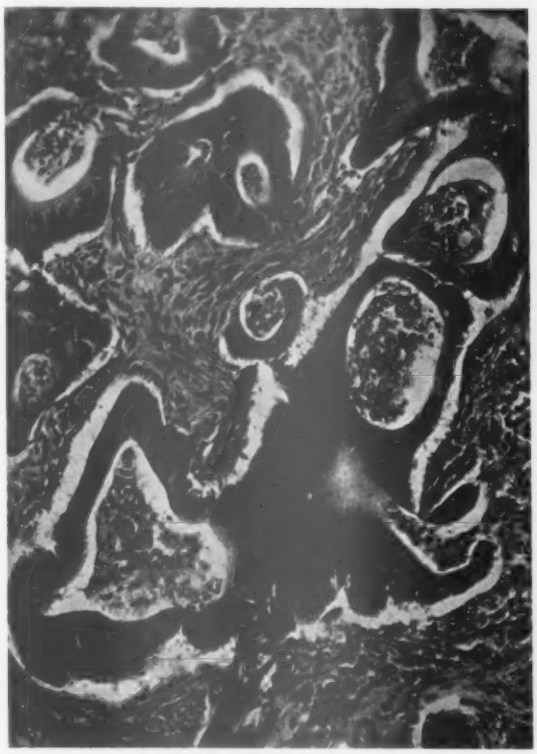

Fig. 6. J. G. This lesion is different from the salivary gland type of tumor. It is a typical malignant adenoma of gastrointestinal type and appears to be of mucous gland origin.

TABLE V

TREATMENT

Eight Patients Living Five Years or More

	Surgical		Irradiation					
			Interstitial			External		
Case No.	Date	Type of Operation	Date	Type	Amount	Date	Type	Amount
1. M. F.	5- 4-27 1-21-28 5-12-32	Local excision Incision and curettage Jaw resection	7- 5-27 11-16-27 10- 3-30	Gold radon seeds Gold radon seeds Gold radon seeds	14.0 mc. 5.0 mc. 13.0 mc.	1-15-28 11-22-33 3-12-34	Radium element pack Radium element pack Radium element pack	10,000 mc-hr. at 6 cm. 72,000 mc-hr. at 6 cm. 48,000 mc-hr. at 6 cm.
2. L. T.			3-28-23 4-14-25 1-31-29	Glass radon seeds Glass radon seeds Gold radon seeds	3.9 mc. 2.8 mc. 9.1 mc.	3-28-23	Brass tray	1,248 mc-hr.
3. H. S.	12- 4-28	Surgical excision						
4. A. H.	6-14-30	Anthrotomy	12-23-21 10- 1-25 12-13-28 1-31-29 6- 7-30 1-27-33	Glass radon seeds Gold radon seeds Gold radon seeds Gold radon seeds Gold radon seeds Gold radon seeds	4.5 mc. 14.0 mc. 13.0 mc. 11.4 mc. 32.5 mc. 15.2 mc.	2-24-33	Radium element pack	24,000 mc-hr. at 6 cm.
5. B. F.			12-22-20 2- 9-21	Glass radon seeds Glass radon seeds	10.6 mc. 7.6 mc.			
6. J. G.	3-22-29	Surgical excision						
7. M. S.		Surgical excision before admission	3- 4-28	Gold radon seeds	8.16 mc.	1- 5-28	Brass tray	2,568 mc-hr.
8. B. T.	1921	Surgical excision elsewhere	3- 8-32 5-31-32 3-21-33	Gold radon seeds Gold radon seeds Gold radon seeds	25.0 mc. 24.0 mc. 15.0 mc.	7-22-32	Radium element pack *Note:* Records of this case prior to 1932 not available.	24,000 mc-hr. at 6 cm.

Two of these cases were treated entirely by surgery, 2 received only irradiation, and 4 were treated by a combination of surgery and irradiation.

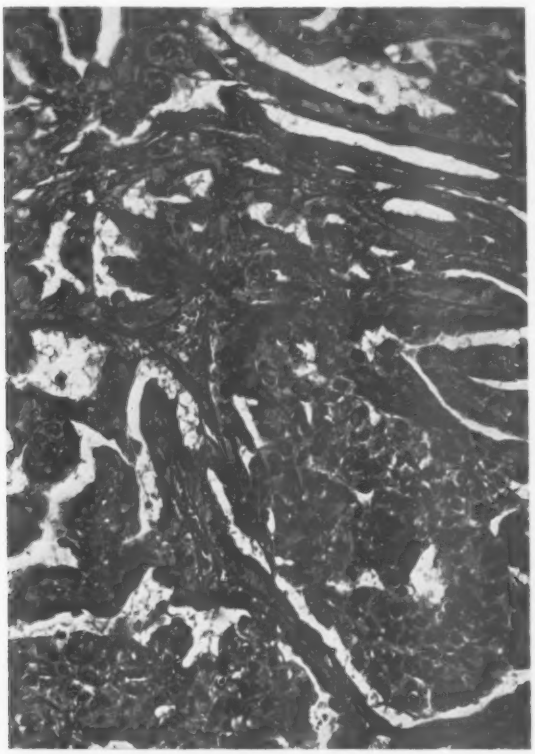

Fig. 7. M. Y. Papillary adenocarcinoma occurring at the base of the tongue. Does not resemble salivary gland tumor and is consistent with papillary adenocarcinoma of the thyroid.

Fig. 8. D. D. Unusual type of adenocarcinoma made up of anastomosing plexiform cell cords of transitional epithelium, possibly of salivary duct origin.

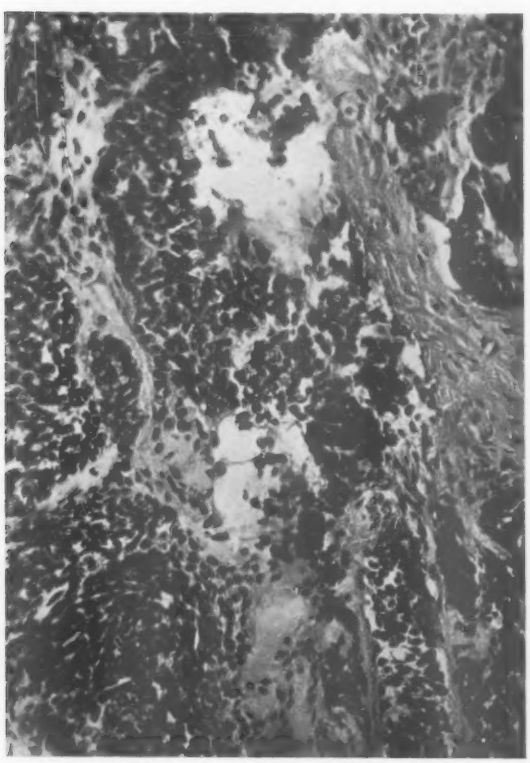

Fig. 9. H. B. Salivary gland adenocarcinoma; in some areas typical, but in others (pictured) quite solid, diffuse, and resembles cellular epidermoid carcinoma. This lesion was radiosensitive.

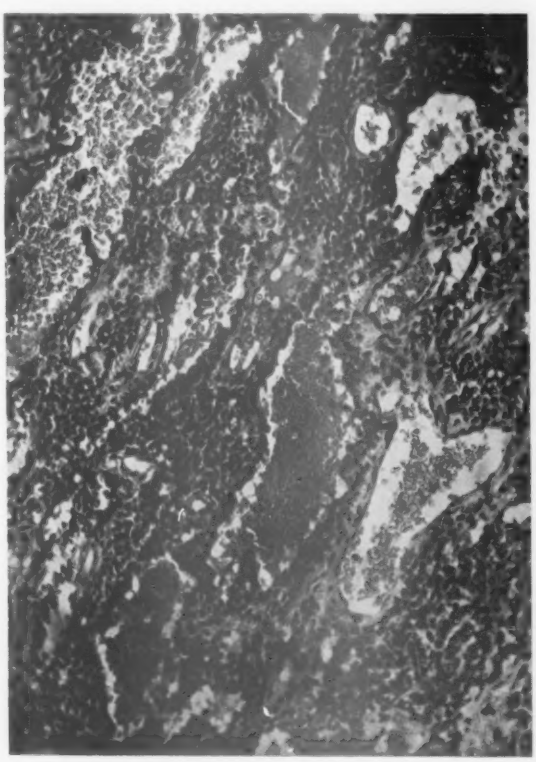

Fig. 10. H. S. Diffuse salivary gland carcinoma with an unusual type of circulation. The only case where the circulation has been of a telangiectatic type.

TABLE VI

LENGTH OF LIFE AFTER TREATMENT

		Less than 3 yr.	3 yr.	5 yr.	10 yr.	More than 10 yr.	Total
Died	With disease	5	1	3	1	0	10
	Without disease	2	0	0	0	1	3
Lost to follow-up	With disease	2	0	0	0	0	2
	Without disease	1	0	0	1	0	2
Living	With disease	1	1	1	0	1	4
	Without disease	6	6	4	0	4	20

Ten cases are known to be living more than five years after treatment, but 2 of these show disease at the present time.

An analysis of the five and ten year results appears in Tables VI and VII.

TABLE VII

CASES ADMITTED PRIOR TO MAY, 1929

	No. Cases	Percentage
Alive and well	8	36.4
Alive with disease	2	9.1
Lost track of	2	9.1
Dead	10	45.4
Total	22	100.0

Of the 22 cases treated more than five years ago 36.4 per cent are alive and well.

SUMMARY

1. A series of 41 cases of intraoral adenocarcinoma is studied in detail from a clinical point of view.

2. These tumors are in the majority of instances derived from the minor salivary glands of the oral cavity but may arise from aberrant thyroid tissue or from mucous glands.

3. The micropathology is only fairly constant but the gross appearance of these tumors is diagnostic.

4. Clinically these growths have a marked tendency to local recurrence, bone invasion, and widespread metastasis by way of the blood or lymph stream.

5. The radiosensitivity of these growths could not be definitely forecast by the microscopic picture, but clinically with one or two exceptions this group was quite radioresistant.

6. Present treatment is by a combination of external and interstitial irradiation followed by cautery excision.

7. The prognosis is poor.

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RADIUM DOSAGE AND TECHNIQUE IN CARCINOMA OF THE TONGUE*

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IN THIS paper, we shall limit ourselves to a brief discussion of the technique and dosage which we are employing in the treatment of carcinoma of the tongue.

It is pretty generally agreed that the application of radium to the surface of the tongue lesion is inadequate to accomplish a clinical cure. Such being the case, it is usually necessary to resort to the implantation of radium or radon.

In the average case of squamous cell carcinoma of the tongue with cell nests, which is radioresistant, we believe it is best to continue the practice of implantation.

Lymphocytic and transitional cell cancer, without cell nests, which are radiosensitive, sometimes recede greatly or even disappear for a time under the influence of surface irradiations only.

In the present state of our knowledge, however, it seems safer to implant every carcinoma confined to the tongue, unless it is too extensive, regardless of its pathologic type. With reference to the implantation method in general, we believe this should be limited to rather small, well circumscribed, favorably situated lesions, in which there appears great probability that radium or radon may be successfully implanted in every part of the growth and in which surface irradiation or excision has been generally found to be inadequate or inadvisable.

If every part of a given neoplasm can be reached with tubules and the attendant conditions are favorable, a clinical cure frequently results.

On the other hand, if every part of a given tumor cannot be reached and the attendant conditions are unfavorable, we believe it unwise to subject patients to a procedure which is somewhat heroic and painful, when it does not promise complete eradication of the disease.

In the treatment of carcinoma of the tongue, as in the treatment of malignancies in general, one must recognize the fact that the powers of radium, while remarkable in many ways, are limited in scope.

It seems quite possible that future studies will show that radium occupies a central position between surgery on the one hand and some constitutional biochemical agent on the other. In the meantime, improvement in our results may be anticipated from improved methods of using radium.

Success in radium therapy of carcinoma of the tongue depends largely on meticulous attention to a chain of details.

A general examination of the patient is desirable. This should include roentgenograms of the lower jaw and chest. Syphilis and diabetes are unfavorable factors in the radium treatment of carcinoma.

The hygienic condition of the mouth should be ascertained. One frequently finds stumps of teeth representing foci of infection. While some have recommended the extraction of the offending stumps or even all of the teeth, we believe it is best not to disturb the tongue by any sort of manipulations in the mouth.

Occasionally an offending tooth may be carefully treated or extracted but if the lesion encroaches on a tooth, we believe it is not advisable to extract it. We believe, in general, that the carcinomatous tongue should be kept at rest, as far as possible. Talking should be limited, and all traumatisms, such as palpation of the lesion to test its consistency, pulling on the tongue, partial operations, etc., should be carefully avoided.

We prefer to delay all ordinary disinfect-

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ing measures until the growth has been treated with short, powerful radium applications, in the manner to be described. These serve the double purpose of reducing infection and more clearly defining the limits of infiltration of the growth.

Biopsy. A few days after surface applications of radium have been begun, the lesion may be carefully biopsied. The lingual nerve is blocked, or cocaine in flakes is carefully applied to the lesion, without rubbing, by means of a cotton applicator.

We believe it is unwise to inject even a drop of novocaine into the lesion for purposes of biopsy. In removing a section, we use a small, sharp cutting forceps or a very small pair of sharp scissors. While objections have been raised both to the forceps and to scissors for biopsy, we have not as yet seen any ill effects that could fairly be attributed to this method. If the tongue were not so motile, a sharp knife and tissue forceps would perhaps be preferable. Differences of opinion exist as to the use of electrical cutting methods for biopsy. Some favor biopsy by diathermy, which is said to seal up the lymphatics and blood vessels and prevent infection. Others hold the opinion that the heat generated in the tissues, resulting in the production of coagulated proteins, may stimulate the carcinoma.

On account of the well-known irritating effect of caustics on carcinoma, we are not in favor of applications of chemicals, such as carbolic acid, or the cautery to the biopsied area. It seems reasonable to believe that a little free bleeding after biopsy, as pointed out by Ewing,[3] may tend to wash out loose carcinoma cells.

Spencer and Cade[9] divide carcinoma of the tongue into two groups—squamous cell carcinoma with cell nests and medullary carcinoma without cell nests. Medullary carcinoma has been further subdivided into lympho-epithelioma and transitional cell carcinoma.

The ordinary squamous cell carcinoma with cell nests occurs in all parts of the tongue but is more commonly encountered in the anterior two-thirds in front of the lingual V. Lympho-epithelioma and transitional cell carcinoma occur on the posterior part of the tongue behind the lingual V.

The common squamous cell carcinoma with cell nests is radioresistant. Lympho-epithelioma and transitional cell epithelioma are radiosensitive. While it has been maintained that varying dosage with radium may be used, depending on the pathologic type, we believe that too much reliance should not be placed on the supposed radiosensitivity of the individual case. We regard it as safer to irradiate each case with the highest possible dosage, rather than limit the dosage and find too late that the tumor is radioresistant.

Methods of Treatment. One must of course consider radium in its application both to the primary lesion and to the adjacent lymph nodes.

The Primary Lesion. Although some have apparently seen the primary lesion benefited by "distance" irradiation with the radium bomb or roentgen rays, our own experience with these methods has been disappointing.

We have adopted the plan of beginning treatment of the tongue lesion by applying daily, for from one to three or more minutes, 500 to 1,000 mc. of radon in rather close contact, being extremely careful to avoid manipulation of the lesion. The radon is screened with 2 mm. of lead and sufficient rubber, so that the glass radon tubes are exactly 6 mm. distant from the surface of the lesion. The radon applicator may measure 2×2 cm.

If implantation is to follow surface applications, not over 250 mc-hr. is given. Dosage varies, however, with the amount of elevation of the carcinoma above the level of the tongue, so that no definite rule can be laid down. If the lesion is larger than the radon applicator so that two or more areas are treated, the areas irradiated should be separated from each other by a distance of 3 mm. The influence of these surface applications in reducing in-

fection is sometimes remarkable. There is also, as a rule, considerable shrinking of the tumor. We have in addition entertained the hope that cancer cells lying near the surface may become somewhat devitalized, so that biopsy and subsequent implantations may be safer. In other words, it seems logical to prepare the soil very carefully for the implantation of the "seeds," provided there is no traumatism to the tumor.

Indications for Implantation. If metastases are absent, we believe that in addition to surface treatment, implantation is indicated in the average case of tongue carcinoma regardless of its pathologic type. We are not in favor of implanting the primary lesion in the presence of metastases, because we believe that when carcinoma has once left its primary focus and migrated to the lymph nodes, permanent recovery is not to be anticipated except in rare instances.

Methods of Implantation. Recoveries in carcinoma confined to the tongue have apparently occurred after the employment of practicaly all of the various implantation methods advocated. The problem at present is, which of the various methods promises the most?

So many factors enter into the problem that true evaluation of the different implantation methods is impossible at the present time. Not all radiologists have equal facilities for using radium and radon, and each one naturally uses the equipment which he has and with which he is most familiar. Moreover, it is not easy to compare results because of the difference in the homogeneity of different groups of cases.

Lead Tubules. We have long since given up the use of so-called removable needles of various kinds containing radium or radon, although some authors still advocate them.

Spencer and Cade regard radium platinum needles, with a wall thickness of 0.5 to 0.65 mm. as superior to tubules containing radon.

At the Curie Institute in Paris, radon platinum needles, with a wall thickness of 0.5 mm., are used.[4]

Both Spencer and Cade and the Curie Institute sew the needles into the tongue and remove them after about seven days.

At the present time we are using lead radon tubules, a description of which we published in 1932.[8]

In 1930 we began the use of radon tubules of pure capillary lead tubing. Later, antimony was mixed with the lead in the proportion of 5 per cent, in order to harden the lead tubing which was found to be too soft for convenient handling. A number of materials were thought of as jackets for radon. We considered lead glass containing various proportions of lead. Finally, we decided to use lead, because of the general experience that ordinary lead bullets may be tolerated by the tissues and remain encysted for years without causing pain or other inconvenience. Our experience, which we hope may be borne out by others, is that these lead antimony tubules do not cause residual pain but are well tolerated, even when they remain permanently in the substance of the tongue.

The lead antimony tubules are 3 to 4 mm. long, with a bore of 0.15 mm. and a wall thickness of 0.3 mm., and contain approximately 0.7 mc. each. These tubules transmit the gamma rays and approximately 2 per cent of the beta rays. We very much prefer to use a larger number of tubules, each containing 0.7 mc., than a smaller number, each containing 1 or more mc.

Assuming that each tubule contains 0.7 mc., we employ approximately the following dosage: For lesions 1 cm. in the longest diameter, 10 tubules; 2 cm. in diameter, 20 tubules; 3 cm. in diameter, 30 tubules; 4 cm. in diameter, 40 tubules; 5 cm. in diameter, 50 tubules. The total amount of radon is thus 7, 14, 21, 28 and 35 mc. respectively. This dosage corresponds fairly well with 10 S.E.D. in the tables published by the Memorial Hospital.[1,6] Compared with the Memorial Hospital dosage, it

will be noted that for the smaller lesions we use a larger dose and for the larger lesions a slightly smaller dose. Our dosage is not quite comparable to the Memorial Hospital dosage, because with lead tubules, in addition to the gamma rays, approximately 2 per cent of all the beta rays pass through the wall. We have followed the general rule of introducing into the lesion the largest dose that we believe will be tolerated without causing serious injury to the normal tissues. With small lesions, therefore, we deliberately overdose the lesion and the adjacent tissue. We have not treated by implantation any lesion larger than 5 cm. in its longest diameter. We believe, however, that a total of approximately 35 mc. contained in 50 tubules is all that can safely be implanted in a single tongue lesion.

Some authors state that since it is impossible to estimate accurately the volume of the tongue lesion, it is futile to describe the dose in relation to a cubic centimeter of tissue.

One must recognize the fact that the action of radium is extremely complex. The effect of radium on the vessels supplying the lesion cannot be mathematically calculated. It seems probable, however, that the good effects of the implantation of radium or radon are to be attributed not only to the direct effect on the carcinoma cell but also to the cutting off of the blood supply and the effects on the surrounding tissues. For these reasons, we think implantation should be done very wide of the entire periphery of the lesion.

Technique. The utmost gentleness should be used in dealing with a carcinomatous tongue. We prefer local rather than general anesthesia. The lingual nerve is blocked in the usual way. In lesions far back on the tongue, lingual nerve block may be supplemented by local surface anesthesia. We use cocaine in flakes or a 2 per cent novocaine solution and inject it distal to the lesion.

For lesions located far back on the tongue, we use curved needles by means of which the affected area can be implanted from the mucous membrane surface with the aid of the laryngeal mirror.

For posterior lesions, we have not used the method, suggested by different authors, of nicking the skin in the submental region and pushing implantation needles straight back through the tongue until they engage in the carcinoma, because we fear that in withdrawing the needles, contaminated by carcinoma, along a tract of healthy tissue, transplantation of carcinoma cells may occur.

We have devised a small instrument for the implantation of radon tubules, a description of which was published in 1922.[7] It consists of a small syringe-like barrel, to which needles of different lengths and curves may be attached. The lead tubules are inserted in the end of the needle and dislodged by a plunger. We regard it as very important that a fresh sterile needle and plunger be used for each tubule implanted, because of the possibility of transplanting cancer cells.

We have found it convenient to slip a small sliding guard or metal node over each needle used for implantation. This contrivance is known as a "cravat-pin guard," and may be obtained at any haberdashery.

The distance from the end of the needles in centimeters and therefore the depth below the surface that each tubule is implanted can thus be accurately measured. We follow the general plan of implanting the lead tubules about 1 cm. apart. It is perhaps needless to say that the tubules are sterilized by dropping them successively in 95 per cent carbolic acid, alcohol and ether. We usually draw a clock-faced diagram of the lesion and mark on the diagram the estimated points of insertion. After the routine implantation, one can go over the lesion and implant additional tubules at strategic points. Patients are not hospitalized and frequently continue their usual occupation.

Pitfalls. We estimate the number of lead radon tubules that will probably be re-

quired in an individual case, and then make about one-third to one-half more than the estimated number. Nothing is more disastrous than to run short of tubules after the implantation procedure has been started. It is very important that the radon tubules be measured several times in the twenty-four hours prior to implantation. While we have never bought and tested radon tubules, as sold to physicians by commercial companies, we believe this practice is not to be commended for general use. When radon tubules cost several dollars apiece, we believe it unlikely that a sufficient number will be bought by the physician or the patient for the individual case. The present method of sealing lead radon tubules by pressure with forceps is identical with that ingeniously devised by Failla for gold tubules.

As long as this method is used, one can never be certain that the specified amount of radon is in each tubule, unless careful measurements are made several times with the electroscope in the twenty-four hours prior to implantation.

Fast or slow leaks may develop which may render a radon tubule entirely inert. We have recently found that radon tubules may leak for more than forty-eight hours before all the radon is out of the tubule.

We do not, at the present time, favor either glass or gold tubules. Glass tubules are efficient but cause unnecessary pain and reaction. Gold tubules left permanently in the tongue sometimes cause residual pain lasting almost indefinitely.

We do not favor removable needles made of platinum or other metal because of their large size, the traumatism from the attached threads which are sometimes sewed into the tongue, the possibilities of increased infection and various other reasons.

We do not agree with those who argue against the use of beta rays as not being true radium therapy and who therefore use radium or radon needles with walls which practically allow the transmission of gamma rays only. We believe, on the other hand, that a certain amount of beta rays and a moderately sharp reaction are not undesirable in tongue carcinoma.

Control of Pain. In some cases to relieve the pain of the radium reaction, when it is at its height, we have used anesthetic wafers of different kinds; in other cases a 5 per cent spray of cocaine. Morphine may at times be required. It has been suggested that injections of alcohol into the nerve trunk might be desirable. Dr. L. J. Pollock[5] advises me that he does not believe such a plan would be practical or effective.

Protection of Bone. When possible, we employ a protective plate of dental compound reinforced by a thin layer of gold. This is attached to the available teeth and is worn by the patient during the first two weeks following implantation.

Metastases. Ewing[2] states that "metastases are unquestionably favored by a malignant atypical structure, by an origin from deep rather than superficial structures, by deep ulceration, by long duration of the disease and by the presence of inflammatory complications."

To these favoring conditions, one may add the occurrence of all sorts of traumatism to the tongue, such as partial operations, rough palpation of the lesion, pulling on the tongue, sewing needles into the tongue, etc.

Extension to the lymph nodes appears to be chiefly by embolism as pointed out by Heidenhain, Ewing and others. Formerly extension beyond the lymphatic collar of the neck was regarded as extremely rare. Distant metastases are now said to occur in approximately 1 per cent of the cases.

Non-palpable Nodes. In the absence of palpable nodes, opinions vary as to the best method of treatment. Some surgeons advocate unilateral block dissection in all operable cases. Others do not operate in the absence of evident metastases. The majority of radiologists appear to favor surface irradiation rather than operation.

Palpable Nodes. Surgical and radiological opinion appears to be greatly influenced by

the type of carcinoma. With the ordinary squamous cell carcinoma with cell nests, surgical opinion with which we agree appears to favor excision but only when one submaxillary node alone is involved. Many believe that surgery should be done only in the presence of a healed primary lesion.

With lympho-epithelioma or transitional cell epithelioma, surgery of lymph nodes has apparently given place to irradiation.

For non-palpable nodes and for palpable lymph nodes believed to be carcinomatous and inoperable, we use the radium bomb method or so-called "distant" irradiation. At 4 cm. distance approximately 10,000 mc-hr. and at 6 cm. 24,000 mc-hr. may be given.

There is some evidence indicating that a combination of the radium bomb and roentgen therapy may be desirable in the treatment of carcinomatous lymph nodes. One should beware of over-irradiating inoperable lymph nodes.

We are not in favor of implanting radium or radon in carcinomatous lymph nodes, although this procedure is endorsed in selected cases by a number of eminent radiologists.

We agree with Lacassagne, who states that "the end results of cases of metastatic gland involvement treated by radio-therapy will remain in doubt for a long time on account of lack of histologic proof that there actually was invasion. It will be necessary to compare large series of cases of similar extent, localization, and histologic character of the primary lesions, with and without treatment, to get some idea of the true value of this therapy."

In conclusion, we would express the opinion that patients must be individualized and treated according to the conditions that are present or may arise, rather than by any definite rules.

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INTRAPERITONEAL INSERTION OF RADON AND GASTROENTEROSTOMY IN CARCINOMA OF THE PYLORIC END OF THE STOMACH*

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STATISTICAL data as to frequency of the occurrence of cancer of the stomach vary to a certain extent in different publications. It is, however, a conservative estimate that over 40 per cent of all cancers occur in the stomach. Furthermore, 60 per cent of all cancers of the stomach develop in the pyloric region, consequently 21 per cent or more than one-fifth of all cancers in both sexes and all ages appear in the pyloric end of the stomach. This type of cancer is thus the most frequent of cancers in any region.

A great many of the patients suffering from cancer of the stomach present themselves for treatment in a far advanced stage of the disease. The reason for this is that the disease in its early stages is silent and presents practically no clinical symptoms. Therapy then becomes extremely difficult and since these advanced cases, as will be seen later, represent probably 90 per cent of all the cases of cancer it is self-evident that any improvement in the methods of therapy of this condition means a solution of not only a most perplexing but also of a major portion of the cancer problem.

SURGERY IN CANCER OF THE STOMACH

The ideal method to obtain a permanent therapeutic result in cancer of the stomach is to do a wide surgical removal of the involved part of the organ or, even better, the whole organ, i.e., to do a partial or total *gastrectomy*. This therapeutic measure, however, is applicable only in the very early stages of the disease, when it is confined to the stomach, the inflammatory adhesions are limited and the lymph nodes are not involved. In the latest report of C. H. Mayo,[7] an exploratory laparotomy was performed in 2,094 cases of cancer of the stomach and in only 736 of these was a gastrectomy done. Thus even in the Mayo Clinic only about 28.4 per cent of all the cases which present themselves for treatment are amenable to radical surgical removal. The percentage of such early operable cases is much smaller in other hospitals.

Peck,[9] for instance, found in an analysis of 527 cases from various hospitals that an exploratory laparotomy was done on 480 patients. Of these no further procedure was attempted in 143, a gastroenterostomy was done in 167 cases and a gastrectomy was done in only 98 cases, or in 20 per cent of the total. Thus, the general average is undoubtedly below 25 per cent. Furthermore, the immediate postoperative mortality was 13.7 per cent in the Mayo Clinic and 28 per cent in Peck's cases, or an average of not less than 25 per cent, which reduces the percentage of cases of cancer of the stomach which were subjected to the radical operation and survived it to below 20 per cent of all the cases which present themselves for treatment. Less than 25 per cent of these surviving the immediate effects of the operation remain well after five years. C. H. Mayo reports 25 per cent which is the highest percentage on record, while Bloodgood[1] reports only 10 per cent of cure. Thus the number of cases which can actually be helped by this method of treatment is well below 4 per cent. The 2,094 cases which had an exploratory laparotomy performed in the Mayo Clinic do not represent the total number of the patients suffering from can-

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cer of the stomach which presented themselves for treatment. This reduces the 4 per cent still further and shows that radical surgery to date does not solve the problem of the treatment of cancer of the stomach and there is therefore an urgent necessity to devise additional methods of surgery.

Gastroenterostomy. The most distressing symptom in cancer of the pyloric end of the stomach which never fails to occur is a severe obstruction of the pylorus followed by dilatation of the stomach, constant vomiting and general intoxication of the organism. A gastroenterostomy, while only a palliative procedure, if properly performed may relieve all the distressing symptoms, make the patient comfortable and may even prolong the patient's life.

Whenever the roentgen examination shows a pyloric obstruction an exploratory laparotomy should be done even when there is evidence of a generalized peritoneal carcinomatosis with free fluid in the abdomen. As a rule, a sufficient amount of uninvolved gastric wall will be found to do a posterior gastroenterostomy, or if it is found difficult to free the posterior wall of the stomach, an anterior gastroenterostomy. The general improvement in the condition of the patient is so great that it is surely worth while to take the small risk which the operation entails.

Analysis of all the operations performed in cases of cancer of the stomach indicates that in about one-third of gastric cancers which are subjected to surgical therapy a gastroenterostomy is performed at present. In my opinion an even greater percentage of patients with carcinoma of the pyloric end of the stomach should be subjected to this procedure.

RADIOTHERAPY IN CANCER OF THE STOMACH

As was stated above, radical surgery, gastrectomy, even in the most favorable early cases succeeds in not more than 25 per cent of the selected cases, and therefore additional methods of therapy are urgently indicated even for all the cases which have undergone a gastrectomy. *Postoperative radiotherapy* in these cases is employed not prophylactically, as we conceive it in bacterial diseases, but in order to inhibit or destroy the remaining minute nodules of carcinoma left after the operation. There has accumulated a sufficient amount of clinical evidence to prove that fully developed discrete primary or metastatic tumor masses of carcinoma may be destroyed by the aid of radiotherapy. It is undoubtedly much easier to accomplish such a result when each tumor nodule is so minute that it cannot be discovered by any means at our command.

In order to influence these remnants after an operation, or the minute recurrent nodules, the whole operative field and its vicinity must be irradiated since the exact location of each nodule cannot be determined. For such postoperative irradiation either high voltage roentgen therapy or surface and distance applications of radium may be employed. Intratumoral insertion of radon, as will be shown later, destroys the major portion of the tumor, and the subsequent surface radiotherapy acts in a manner similar to postoperative irradiation.

Advanced cases of cancer of the stomach in which neither a surgical removal nor an intratumoral insertion of radon was done, are, in my experience, generally not influenced either by high voltage roentgen therapy or by surface or distance application of radium. Such treatment is generally followed by the development of severe cachexia or the recrudescence of a previously present cachexia or anemia. This phenomenon may be due to the increased necrotization of the tumor masses through the action of the irradiation and the absorption of such material with the additional leucopenia caused by the irradiation. Mudd, Emery, Meland and Costolow,[8] in their recent report on three years' experience with 600 kv. roentgen therapy, state that the tumor sensitivity seemed to be diminished by the presence of infection and further, that during irradiation the leuco-

cytes fell to about 50 per cent of their initial value. In my experience the same is true when intensive dosage is given with 200 kv. roentgen therapy. Advanced gastric carcinoma is usually accompanied by ulceration, infection and low leucocyte count and is therefore not suited for high voltage roentgen therapy of a sufficient intensity to produce results.

Intraperitoneal Insertion of Radon. For the last fifteen years I have made use extensively of the method of insertion of capillary tubes of radon into tissue.[2,3,4,5,6] Experimentally, the work was done on normal plant and animal tissue (liver, spleen, bone, marrow, muscle and testes) and on plant and animal tumors. Clinically, the method was employed in epithelioma of the skin, lip, tongue, mucous membrane of the mouth, tonsils, carcinoma of the breast, cervix, rectum, urinary bladder and prostate. At the beginning, glass capillary tubes were employed and later gold tubes. The advantages of the intratumoral insertion of capillaries of radon over surface or distance application of radium consist in the fact that the former method allows an even distribution of small quantities of radiation throughout the tumor and that on account of the intimate contact of the radon with the tumor cells, the total amounts are comparatively small and local results are obtained without any general deleterious effect on the organism.

The analysis of the experimental and clinical results obtained shows that the action of the radon capillaries on plant, animal and human tissue is quite analogous. The immediate result of this action is complete necrotization of the first zone of tissue immediately surrounding the radon capillary. This zone is very minute in extent and apparently filters off the softer radiations. The second zone, under the influence of the harder radiations, shows a cellular degeneration. Examination of the tissue six to eight weeks after the insertion of the radon shows that the necrotic tissue is completely absorbed and replaced by connective tissue. In plant tissue a cellulose cushion is formed around the radon capillary which apparently plays a similar rôle to the connective tissue in animal and human material.

I observed that when the insertion is made into a solid nonulcerated tumor situated subcutaneously or next to a mucous membrane and covered by a normal skin or a normal mucous membrane and when the capillaries are placed at correct distances from each other, the tumor shrinks without sloughing or ulceration. It thus seemed reasonable to presume, a priori, that an insertion may be made into a tumor covered by peritoneum without causing sloughing of the tumor and consequent peritonitis.

For the last fifteen years I have used this method extensively in intraperitoneal tumors of the stomach, the colon, the rectum, the uterus, the ovaries and in retroperitoneal tumors.

I perform an exploratory laparotomy and when I find that a radical surgical removal of the tumor cannot be done, I then insert the capillaries of radon into the tumor. This is followed by a necessary palliative surgical procedure. The laparotomy incision is immediately closed. No sloughing or ulceration of the tumor or any abscess formation is observed. Drainage is rarely used and the laparotomy wound heals by primary union. In one case following such an insertion, a panhysterectomy was performed, and the patient remained well after both operations. My first publication on intraperitoneal insertion of radon appeared in 1922.[2]

The question is still debated whether the insertion into a tumor (so-called interstitial irradiation) of removable radium needles or an insertion of buried radon capillaries (so-called radon implants) is more advantageous. I have used both and have not observed any difference in their clinical action. Radon has the advantage over the radium salt that it may be used for both methods. In tumors, however, located intraperitoneally it is self-evident that the insertion of buried capillaries of radon is

the method of choice. In 1929 Dr. M. Donaldson of London, reported on intraperitoneal insertion of removable radium needles, but this necessitated the performance of two abdominal operations within one week, which is an entirely unnecessary hazard.

INTRAPERITONEAL INSERTION OF RADON AND GASTROENTEROSTOMY IN CANCER OF THE PYLORUS

I have had under my control only the advanced cases of carcinoma of the pyloric end of the stomach; nevertheless, the results obtained by the combination of palliative surgery and insertion of radon seem to be quite promising.

The following cases may serve to illustrate the methods and results in this type of cases:

Case 1. O. B., male, aged fifty-five, was admitted to the hospital on October 3, 1921, with symptoms of pain in the stomach, nausea and severe attacks of vomiting. The patient had lost 45 pounds (20 kg.) within the last six months.

On examination there was a tumor noted in the middle line of the abdomen, 5 cm. above the umbilicus, about the size of an orange, freely movable.

Roentgen examination disclosed a complete obstruction in the pyloric region. None of the barium suspension passed beyond the pylorus.

Laparotomy was performed on October 4. A tumor was found to be situated in the second part of the duodenum which could not be removed surgically. Radon was inserted throughout the tumor and then a posterior gastroenterostomy performed. On November 9, the patient was discharged clinically improved, there was no vomiting and the bowel movements were regular. The mass appeared to have receded in size. On December 8, the patient was readmitted to the hospital for further study and treatment. He had gained 16 pounds (7.5 kg.) since the operation and the tumor mass was not palpable.

A second laparotomy was performed, the tumor was one-fourth of the original size, and very hard in consistency. Again radon was inserted into the tumor mass and the laparotomy wound closed.

On December 21, a second roentgen examination showed that the barium meal filled the stomach completely; gastric contents began to empty through a stoma into the jejunum immediately. Three hours later a very small gastric residue remained; the appearance was such as to suggest that part of the stomach contents was passing along the normal route.

The essential points in this case are that the whole volume of the tumor shrank considerably and this shrinkage apparently also took place in the depth of the tumor so that the lumen of the duodenum became patent and the original obstruction of the pylorus was partially relieved.

Case 11. B. N., male, aged fifty, was admitted to the hospital on August 11, 1925, complaining of pains in the stomach and back for two years mostly at night; vomiting, loss of appetite and of weight (about 45 pounds or 20 kg.) and weakness. He had marked constipation but the stools were not bloody. The vomitus consisted of partly digested food. The patient had no difficulty in swallowing.

Physical Examination. The abdomen was slightly scaphoid in contour. The liver was felt 1 inch below the costal margin; it was of normal consistency and not nodular. Midway between the umbilicus and the xiphoid process to the right of the midline could be felt a round, firm mass the size of an orange, quite nodular and apparently not attached to the abdominal wall. It was not tender on pressure. No other masses were palpated anywhere. The spleen and kidneys were not felt, and no large, discrete glands were present. Rectal examination did not reveal any additional pathology. A provisional diagnosis of carcinoma of the pylorus was made.

Roentgen examination on August 25 prior to operation showed the stomach markedly atonic in type and dilated. Even in the prone position, the stomach lay 7 cm. below the iliac crests. No filling defect of the stomach or duodenum was observed. Two and six hours after eating, more than half the meal was still retained in the stomach. Twenty-four and fifty-four hours after eating, more than one-third of the meal was still retained in the stomach.

In view of the complete pyloric obstruction, a gastroenterostomy seemed indicated. A provisional diagnosis of marked pyloric obstruction was made, the etiology of which could not

be determined from the roentgenograms. It was decided to do a laparotomy.

Operation and Result. A laparotomy was performed by me on September 21. An upper right rectus incision was made. A very dense neoplasm involving principally the anterior gastric wall in the prepyloric region was found. It extended up to the lesser curvature and was deep enough to cause pyloric obstruction. The lesser omentum and the regional lymph nodes were also involved. The liver and gallbladder were free grossly. A biopsy was done on a small redundant part of the neoplasm in the central upper part of the lesion; then radon capillaries were inserted into the neoplasm transperitoneally, eight at intervals throughout the anterior aspect and four through the small part of the tumor which "saddled" over onto the posterior wall. Then a posterior gastroenterostomy was done. The wound healed by primary union without any rise in temperature. The patient's general condition improved continually.

Examination on October 11 showed the abdomen was soft throughout. The pyloric tumor was not palpable. The general condition of the patient seemed to be very good. In three months, the patient gained 23 pounds (10 kg.).

On January 10, 1926, the mass was not palpable, indicating a diminution in the size of the tumor. The general condition was such that I considered an attempt at removal of the pylorus should be made. The patient had in the meantime received a complete course of high voltage roentgen therapy.

On February 3, I performed a gastrectomy. An incision was made parallel to the old incision and the abdomen exposed. The stomach was found adherent, particularly to the pancreas. No glands were felt in the abdomen. Two intestinal clamps were applied to the stomach proximal to the tumor, and an incision was made between them. The tumor was removed with a portion of the duodenum. A great deal of bleeding was encountered at the pancreatic surface which could not be controlled by ordinary methods. Clamps were allowed to remain on the vessels and Mikulicz's tampon was applied to the oozing surface. On February 5, all the clamps were removed, together with the compression drains and secondary sutures of the skin applied.

On February 8, there appeared a diffuse drainage of bile. The rest of the wound was satisfactory, and the general condition of the patient was fair. The patient, however, refused to take nourishment consistently, and died February 27, of marked asthenia.

Pathologic Examination. The pathologist reported adenocarcinoma of the stomach and metastatic carcinoma in the lymph nodes. The tissue of the removed pylorus showed extensive connective tissue formation with scattered carcinoma cells.

Case III. S. A woman, aged fifty-eight, admitted to the hospital October 31, 1925, complaining of pain, which she first noticed five years prior to admission in the vicinity of a laparotomy scar. There had been an operation for ovarian cyst eighteen years before. The pain would disappear for two or three months and then return. It was very slight and was neglected until it returned in the summer of 1925 accompanied by indigestion. She had some loss of appetite, chiefly occasioned by fear of eating. There was no vomiting, but she had lost 15 pounds (6.8 kg.) in six months.

Physical Examination. The patient appeared fairly well nourished and not anemic or cachectic. The abdomen was soft and not distended. The upper portion presented a hard, nodular mass about 1 cm. above the umbilicus in the midline, and extending over to the right about 4 cm. from the linea alba. On the left it disappeared below the costal margin at a distance of about 4 cm. from the linea alba. The relation of that mass to the liver could not be defined clearly.

Bimanual vaginal examination showed a small, freely movable uterus. The adnexa could not be made out. The right ovary was felt indistinctly. No abnormal masses were felt anywhere.

Roentgen examination of the gastrointestinal tract prior to operation disclosed an irregularity in the pars media, along the greater curvature at a distance of 3 cm., with a failure of visualization of the pyloric end of the stomach for a distance of 5 cm. which was constantly present in all the films. Two and six hours after eating the residue of one-fourth of the meal was seen proximal to the apparent lesion. Twenty-four hours after eating the stomach was empty. Stasis was present throughout the colon.

A provisional diagnosis was made of carcinoma of the pyloric portion of the stomach including both the greater and the lesser curvature.

The size and appearance of the mass, together with the roentgenographic analysis, showed that the involvement of the gastric wall was very extensive and that the tumor was beyond any chance for radical removal. However, it was thought that an exploratory laparotomy should be done.

Operation and Result. On November 10, I performed a gastroenterostomy and radon insertion. An upper right rectus incision about 6 cm. long was made. It was found that the area of neoplastic involvement was in the prepyloric portion of the stomach. Biopsy was done by incising into the serosa of the stomach, four capillaries of 0.3 mc. each were immediately inserted into the bed of the resulting opening, and the latter was closed with plain gut. Eleven capillaries of 0.3 mc. were inserted into the neoplastic area. The usual posterior gastroenterostomy was done. The wound healed by primary union and symptoms disappeared. The patient's general condition improved. The pathological report was adenocarcinoma.

Roentgen examination three months after the operation showed a rapid filling of the proximal small intestines through the gastroenterostomy stoma. There was some irregularity of the greater curvature of the stomach about 3 cm. from the stoma. Two hours after eating, a slight gastric residue was seen in the region of the stoma. Six hours after eating the stomach was empty. Stasis was seen in the terminal ileum, the head of the meal just reached the ascending colon. Twenty-four hours after eating there was stasis in the left half of the colon.

Roentgen examination one year after the operation showed a rapid passage of the meal through the stomach with a filling of the proximal small intestines. There was some irregularity along the greater curvature adjacent to the stoma. Two hours after eating a minute residue was present in the region of the stomach. Six hours after eating the stomach was empty.

The patient's condition appeared to be improved since the last examination. The patient received local applications of radium over the epigastrium after the operation. She also received a course of high voltage roentgen therapy over the abdomen. She had been on a soft diet. So far she had more than maintained her weight and her general condition was, in the main, satisfactory.

The patient was last seen on December 16, 1926. The tumor mass had not increased in size since the last examination. The general condition of the patient seemed to be fairly satisfactory.

Case iv. A. M., female, aged sixty-five, entered the hospital, October 30, 1926, complaining of epigastric pain for three months previous to admission and a loss of 23 pounds (14 kg.) during the past six months. There had not been any nausea, vomiting, hemoptysis, bloody stools or jaundice.

Physical Examination. The patient was somewhat emaciated and anemic; the abdomen was soft and relaxed and no fluid was noted. In the epigastrium, there was a firm, slightly tender mass about the size of a baseball. This mass was movable within certain limits. No other masses were palpable and no other abnormality was found anywhere. A clinical diagnosis of carcinoma of the stomach was made.

Roentgen examination showed a distinct narrowing in the pyloric portion of the stomach involving the greater curvature for a distance of about 3 cm. Seven hours after eating there was a moderate residue in the stomach proximal to the narrowing. The head of the meal had reached the hepatic flexure. Twenty-four hours after eating, traces were still present in the stomach.

Operation and Result. On October 31, I opened the abdomen by a median incision 7 cm. long; the stomach was exposed and a tumor mass was found involving the pyloric end of the stomach; lymph nodes of the small omentum were found to be infected. Therefore, pylorectomy was not done, but eighteen capillaries of radon, 0.3 mc. each, were inserted throughout the tumor and a classic posterior gastroenterostomy was done. A small drain was inserted and the peritoneum, fascia and muscles were united with two rows of continuous catgut sutures, silkworm gut being used for the skin.

The patient made an uneventful recovery. There was no rise in temperature throughout the postoperative course, and the wound healed by primary union. At the examination seven months after the operation, the patient is in good condition and is taking food without any pain or discomfort.

Case v. B. S., female, aged forty-four, was admitted to the hospital October 27, 1926.

About two years before, the patient had had slight pain in the epigastrium independently of meals; there was no vomiting. This condition continued until six months before admission, when she began to have constant pain in the epigastrium both day and night. She began to vomit at times, independently of the intake of food. The vomitus was coffee colored. Once she vomited blood.

Roentgen examination of the gastrointestinal tract, October 29, showed the greater curvature of the stomach 9 cm. below the intercostal line. The stomach was atonic in type and dilated with an inconstant type of irregularity and filling defect of the pyloric portion.

Physical examination on October 30 showed the following condition: The patient appeared anemic and emaciated. The abdomen was soft and not distended. In the midline 1 inch above the umbilicus, there was a mass felt, the size of which could not be definitely made out. While the position of that mass was low for pyloric carcinoma, the roentgenograms showed a very distended low-lying stomach. Therefore, it seemed most probable that the condition was carcinoma of the pylorus with complete retention. Rectal and vaginal examination showed no abnormalities.

An exploratory operation with a possible gastroenterostomy and radium insertion was decided on.

Operation and Result. On November 1, I inserted radon in the tumor, excised a lymph node and performed a posterior gastroenterostomy. A left upper mid-rectus incision was made. The stomach was found to be involved in the prepyloric and pyloric regions, chiefly over the lesser curvature, the involvement causing stenosis of the pylorus. Bands of adhesions were found all about the stomach. The involved portion of the stomach was hard and nodular to palpation. Many hard and nodular mesenteric and retroperitoneal glands of all sizes were found and one was removed for pathologic examination. Then fourteen capillaries of radon, each 0.3 mc. in strength, were inserted throughout the tumor mass, but chiefly in the proximal portion of the stomach. The total amount of radon inserted was 4.2 mc.

A posterior gastroenterostomy was then performed in a classic manner, and the abdomen was closed without drainage. The patient made an uneventful recovery. The temperature never rose above 100°F. A gland removed at operation showed metastatic adenocarcinoma.

Subsequent examination November 13 and December 1, 9 and 12 showed the patient progressing favorably in every way. On November 29, she weighed 108 pounds (49 kg.); December 13, 115 pounds (52 kg.), and December 25, 119 pounds (54 kg.).

The patient made an uneventful recovery. She gained 35 pounds (16 kg.), and at the last roentgenographic examination May 14, 1927, the gastroenterostomy was functioning perfectly and the general condition of the patient was satisfactory.

Case VI. M. L., male, aged forty-seven, was admitted to the hospital on October 8, 1930, complaining, for the last three months, of epigastric pain, sour eructation and vomiting one hour after meals. He had lost 15 pounds (7 kg.).

Physical Examination. The patient appeared emaciated and anemic. The abdomen was soft, not distended and no free fluid noted. The liver and spleen were not palpable. In the epigastrium there was noted, on palpation, in the midline, a diffuse hard mass, the size of which could not be definitely made out. Rectal examination showed no abnormality.

Roentgen examination prior to the operation showed the stomach to be markedly atonic and dilated. The greater curvature was located about 12 cm. below the iliac crests. No filling defect was noted in the stomach or duodenum. There was marked pyloric obstruction. Twenty-four hours after eating more than one quarter of the meal was still retained in the stomach. A diagnosis of pyloric obstruction was made, the etiology of which cannot be determined from the roentgenograms.

Operation and Result. A laparotomy was done by me on October 15, 1930. An upper right rectus muscle incision was made. A hard nodular mass was found in the pyloric region about 4 cm. in diameter, involving both the greater and lesser curvature. There were found many adhesions and enlarged lymph nodes. The case was not suited for gastrectomy. A biopsy was taken, radon capillaries were inserted throughout the tumor and this was followed by a posterior gastroenterostomy. The wound healed by primary union without any rise in temperature. The patient made an uneventful recovery and gained 20 pounds (9 kg.) within the next few weeks.

Microscopical examination of the biopsy material showed diffuse scirrhous carcinoma. The patient has had several courses of radium and roentgen therapy since.

Roentgen examination on June 1, 1934, or more than three years and eight months since the operation, showed the stomach to be in a high transverse position. It empties promptly, both through the gastroenterostomy stoma and to some extent through the pylorus. Five hours after eating the stomach is empty. The general condition of the patient is good and the epigastric tumor cannot be palpated.

COMMENT

The major part of the work was done while I was director of the New York City Cancer Institute, on the material of the institution. The patients admitted to the hospital of the Institute are always in an advanced state of the disease. They belong to a shifting population and present extreme difficulties to a clinical follow-up. However, the analysis of the cases presented here, as well as of the many others that I have treated, shows that gastroenterostomy plus radon insertion is usually followed by an uneventful recovery. There is no rise in temperature, and no peritoneal irritation or subsequent sloughing of tissue. In a word, the insertion of radon does not add in the least to the surgical hazard of the gastroenterostomy. Case I was included here, though it presented an obstructing tumor of the duodenum. Clinically, however, it behaved like a tumor of the pylorus. In this case, as well as in Case VI, the shrinkage of the tumor was evidenced by the fact that the pyloric obstruction was partially relieved. In Case II, an attempt was made to follow the gastroenterostomy subsequently with a radical removal of the pyloric tumor. A gross inspection of the pyloric tumor at the second operation showed distinctly that the tumor had shrunk and the microscopic analysis showed that while there was carcinomatous tissue present, there was also an extensive newly formed connective tissue surrounding all the islands of carcinoma. Case III was doing well sixteen months after the operation and Case VI is well today, three years and eight months since the operation.

The method presented here is not a radical method of treatment of cancer of the stomach and Case VI probably survived the operation so long because of the comparatively benign course which the disease took, as happens occasionally in cancer of the stomach. The method, however, represents a palliative procedure which may prolong life and increase the patient's comfort more than a gastroenterostomy alone and, what is of even greater importance, the procedure checks the peripheral growth of the pyloric tumor and therefore prevents the closure of the gastroenterostomy stoma. It also seems to arrest the progressive necrotization and sloughing of the tumor. The patients on whom I operated did not regurgitate or vomit, though I did not consider it necessary to prolong the operation by a surgical exclusion of the pyloric tumor. Much better results can certainly be obtained in earlier cases bordering between the operable and inoperable ones.

Cancer of the pyloric end of the stomach must remain a surgical domain but the orientation of the surgeon should change. He must operate more frequently and less radically. He must either be an expert radiologist himself or must operate only in close cooperation with an expert radiologist.

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Vol. 34, No. 1

COMPLICATIONS AND INJURIES IN RADIUM THERAPY*

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COMPLICATIONS are among those perplexing factors in medicine which make the care and treatment of patients so much more difficult. In some instances we can forsee such conditions while in others it is quite impossible with the limited means at our command to prevent or mitigate these occurrences.

In certain fields of medicine complications are normally expected and combatted as they appear; such conditions are accepted phenomena, as, for instance, in the case of exanthematous and infectious disease.

In some surgical conditions, too, because of associated infections or mechanical difficulties, complicating sequelae may be expected and measures to combat them prepared for in advance. In fact, up to the latter part of the nineteenth century the methods for handling complications in medicine and surgery were to a large extent standardized. However, it was not until the past decade that the hit-and-miss method of clinically employing radium therapy was replaced by a more rational system of control which took into consideration all the physical, biological and physiological factors associated with the patient and the remedy employed.

Although it was the accidental radium burn of Becquerel that gave birth to radium therapy, the subsequent occurrence of radium burns following upon this new therapy very nearly relegated this method of treatment to the limbo of other cast-offs of medicine.

In the early enthusiasm following its discovery, radium was hailed as a panacea for many ills, especially cancer. And because its latent possibilities for harm were not recognized until the injurious effects had been produced, all types of cases were treated with radium without those necessary safeguards we have learned by experience to observe today. It is not surprising, therefore, that upon the appearance of the later destructive manifestations of radium there occurred a sudden reversal of feeling towards the use of this energy and it began to be discarded. Fortunately, however, some far-seeing workers, who realized that a better knowledge of radium therapy was needed, studied the effects of this agent more intensively and by experience gradually learned to control its action to a greater or lesser degree. They found that a disregard of the essential physical and biological factors, learned as was only possible through clinical experience, led to unfortunate results.

From our observation and experience we are definitely of the opinion that radium injuries are in many instances due primarily to faulty technique employed in its use.

In the early period of radium therapy great emphasis was laid on ingenuity in devising various means of applying radium to the patient, while associated factors were neglected. Subsequent observations have indeed proved how these early destructive radium sequelae might have been avoided. As a rule, injuries following radium therapy can be traced to failure in diagnosis, mistakes in judgment, errors in technique and mistakes in after-care of the patient.

As to diagnosis, error is rather common; time and again we have seen benign lesions treated as malignancies, with excessively high doses of radium which were

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followed by ulceration and necrosis. Such excessive doses might have been of value in treating hopeless cancer neoplasms, but certainly are out of place in benign therapeusis.

By clinical experience we have learned to differentiate between the definite radioresistant tumor and the type that responds readily to radium therapy. Persistent repeated radium applications lead to necrosis and destruction of normal tissues. Scar tissue is radioresistant; excessive treatment causes it to break down and become necrotic.

The historic rule of trial and error no longer is permissible in proper radium therapeutic practice. Today our judgment as to when and how to use radium in the treatment of a given case or condition is based on the results gained and is dependent on knowledge, specialized training and experience. Haphazard guesswork no longer is tolerated in proper treatment and one must decide on radium therapy with as much care and understanding as is exercised in judging whether or not to operate in any specific case. Associated conditions, the proximity of vital structures, the presence of infection, all affect the decision as to the use of radium therapy. Because the newer method of employing radium in the form of emanations sealed in small tubules offered such an apparently easy method of directly treating malignant growths, it was not at once realized that these might cause normal tissue necrosis and fatally puncture vital structures. We have seen several cases in which radium necrosis extended into the trachea and pericardium, into large blood vessels and the brain and caused an early fatal outcome.

While in some instances errors of judgment in connection with surgical procedures may possibly be corrected subsequently, a mistake in the employment of radium therapy can seldom be corrected later without practically destroying vital structures or even killing the patient. In not a few cases improper judgment in the use of radium may make a bad condition infinitely worse and render the patient far more miserable. We have seen small keratotic, moderately slow-growing lesions on old people treated with destructive radium therapy which overpowered the already senile normal tissues so that the subsequent necrotic effects of radium could not be repaired, and gradual persistent destruction of the whole surrounding area followed. Subsequent attempts at repairing such damage proved only more destructive and resulted in the agonized death of the patient.

In our opinion, untoward effects from carefully planned radium therapy are due in most instances to error in technique. This may take the form of overdosage or underdosage or it may be the employment of the wrong method of application of the radium. In some instances, local surface applications could have prevented necrotic results had they been used instead of interstitial irradiation. The placing of applicators at improper distance from one another, or in too great proximity to other sensitive structures or in failing to take into consideration the physical rules of crossfiring and back-scattering known to occur in this form of therapy cause destructive injuries.

It is most regrettable that so useful an energy agent should be condemned because the physician improperly employs an enormous dose on a lesion that would have responded well to a small amount of radium dosage. The consequent destruction of normal tissue is then blamed upon radium, instead of upon the inexperience of its user where it rightfully belongs. While all of us, even the well-trained therapists, make mistakes and are responsible for some unfortunate incidents, I have never yet seen a case of radium burn which was not due to ignorance regarding proper technique and correct usage.

Infection plays an important part in failures in radiation therapy, just as it does in other phases of medical and surgical procedures. Not until quite recently, however, was this factor fully realized. It

was Janeway, one of the early, really great students of radium therapy, who called attention to the necessity of seriously considering the presence of infection as an offset to the employment of radium therapy. Fuller understanding of this factor and employment of aggressive measures for its control have made radium therapy of cancer of the cervix the safe method of choice today for this disease. The clearing up of associated infections is an essential part of the technique in any form of radium therapy.

Because we have learned by experience how destructive to the vitality of the bone tissues radium can be, it behooves the therapist so to choose and devise his method of treatment as to avoid as far as possible any destructive action on bone tissue. This is particularly necessary in treating lesions about the mouth. We have seen in more than one case how neglect of this factor caused unnecessary misery to patients otherwise not seriously invaded by cancer.

Because of its poor recuperative powers, cartilage is readily destroyed following technical errors in radium therapy. In the treatment of lesions involving this type of tissue or associated with it, unusually careful technique is required. Tracheal cartilage necrosis has all too often caused the agonizing death of patients incorrectly treated by radium directly implanted in its vicinity.

Repeated radium therapy always requires extreme care. Following the first treatment by radium, the tissues no longer present the same biological and physiological condition as in the original normal state. Only those skilled by training and experience should attempt a technique that calls for repeated radium applications on any given area. Neglect of these considerations has time and again caused intractable destructive ulcerations and led to regrettable fatalities.

Excessive radium dosage in the treatment of lesions of the cervix may lead to severe necrosis with fistula formation into the rectum or bladder. In our opinion in most instances such fistulae are due to errors in technique, except of course in those few cases where direct malignant tissue destroys the continuity of the vaginal walls.

Overdosage, lack of sufficient filtration of the radium applicator and failure to efficiently protect surrounding tissue with gauze packing properly placed invariably lead to necrosis and fistula formation.

If the after-care of surgical patients is considered of equal importance with the technical manipulation in handling the disease itself, then in radium therapy after-care of the local condition in the patient is of fundamental importance to the permanence of any effective result.

In all cases where radium is employed, its effect on the blood and blood-forming system must be taken into consideration. This effect may be so severe in some instances as to warrant supportive transfusion being given the patient.

Its local effect on the supportive structures of superficial tissues may render these sensitive to injury. It is of real importance therefore to protect the treated parts of the body from exposure to irritation of any sort. We have seen a severe case of skin necrosis following the application of liniment to an area previously treated by radium. In another instance, scratching of the skin previously irradiated caused an intractable ulcer which required surgical interference for control. In another instance forcible dilatation of a radium sclerotic-healed lesion of the rectum caused rupture of the gut with necrosis, infection and death of the patient. Post-radium care of tissues so treated requires careful and intelligent thought.

In the treatment of certain conditions, by reason of location, radium reaction may lead to more or less undesirable complications. Edema, as a principal concomitant reaction, must be expected if the lesion being treated is near some organ or viscera which would be affected by pressure. On the face, lesions about the eye may, follow-

ing radium therapy, swell considerably, producing an edema affecting the eyes. This condition may often be relieved with warm wet dressings. In the mouth, swelling of the tongue or of surrounding tissues may affect speech, swallowing and even breathing. Such conditions require careful hygienic care and symptomatic treatment.

In many of these cases, feeding by mouth being almost impossible, resort must be had to supplying needed nourishment to the body by intranasal tube or rectal feedings, hypodermoclysis and intravenous infusions of fluids.

Laryngeal lesions under treatment may be accompanied by swelling of the glottis of such a character as to block all breathing and make an immediate urgent tracheotomy necessary.

Perforations associated with radium treatment of esophageal lesions call for unusually careful expectant treatment, if the patient survives at all the early shock of this accident. The insertion of seeds or tubes in the esophagus requires skill and experience, for improper, inefficient filtration or overdosage may cause necrosis and perforation with fatal results.

Hemorrhage from radium eroded vessels occurs at times, especially in the mouth and in large ulcerated areas under radium treatment. Where possible, immediate ligation should be attempted and treatment carried out as in any other hemorrhagic emergency. In cases which may be suspected of later bleeding, pre-radium ligations of associated blood vessels should be carried out.

In the treatment of lesions of the uterus and cervix, gynecological complications that occur in this area during surgical manipulations are treated along gynecological lines. Infections, perforations and fistulae may be cared for sometimes by operation.

Radium therapy to the cervix or uterus in the presence of latent adnexal infection, especially gonorrhea, may stir this to an acute stage with peritonitis and abscess formation. Abscess in the cul-de-sac should be drained through a colpotomy. Expectant treatment is the method of choice in cases of exacerbated adnexal infections associated with radium therapy.

CONCLUSIONS

Radium therapy requires training and experience and attention to the essential physical and biological factors associated with it.

Injuries following radium therapy are traceable to failure in diagnosis, mistakes in judgment, errors in technique and mistakes in the after-care of the patient.

Radium injuries are in many instances due primarily to faulty technique and are in most instances preventable.

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CORRECTION OF DIETARY ERRORS IN CONNECTION WITH RADIUM TREATMENT*

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MOST of the experimental work that has been done on cancer has been undertaken with the idea of attempting to discover local causes and in the hope of finding a local cure. Much of the work has failed to consider the individual as a whole. Such animal work as has been carried out along this line has been on rats and other animals receiving approximately correct diets, and the results have been oriented in connection with humans, most of whom are on incorrect diets.

Believing that a study of the diets of a number of persons suffering from various kinds of tumor and cancer might be valuable, an inquiry was started in 1922 and continued through 1932. The number of patients involved was 2,707. Inquiry was made as to food habits for as far back as the patient could remember and the relative amounts of various foods noted. The consumption of bread, sugar, meat, dairy products, eggs, fruits, vegetables, fats, and salts were noted. Later these were divided into two classes—vitamin-containing foods and non-vitamin-containing foods.

There is some difficulty in making such a clear-cut division, as some so-called non-vitamin foods do contain very small quantities of these elements, and raw fruits and vegetables contain vitamins, some of which are destroyed by cooking. In our calculations we considered vitamin C as destroyed by ordinary household cooking and vitamin B as not destroyed by ordinary cooking temperatures in a five minute period, but that after that time a destruction of this element takes place in proportion to the time involved, long cooking having a completely destructive effect. In alkaline media these vitamins are destroyed very quickly at ordinary cooking temperatures but mildly acid media in the presence of cooking temperatures are relatively protective. Considering these matters we placed in the non-vitamin class, sugar and all white flour products, also potatoes and salt meats. In the vitamin-containing foods we placed, milk, cheese, butter, eggs, raw fruits, vegetables, and whole grain products, fresh fish, oysters and other sea foods. The idea back of the inquiry came as a result of noting that patients treated at the University Hospital where all patients were paupers and therefore when released from the hospital did not have the means to provide themselves with good foods, did not do as well as private patients and had a larger percentage of recurrences. It was assumed then that good nutrition had something to do with the efficiency of the radiation treatment and also in protecting the patient from regrowth of his neoplasm. The word regrowth is used instead of recurrence because in many cases it was evident that a completely new growth occurred as a result of etiologic factors not having been removed. These factors we found might be either constitutional, such as mouth cancer coming back in syphilitics after treatment was discontinued, or local, such as lip cancer regrowth after the patient's returning to the use of tobacco.

In checking our group of approximately 3,000 cases, two things at once became plainly evident, that all were on more or less deficient diets and that none had cancer as a single disease. The deficiencies were in calcium, vitamins and iodine and cellulose; the concurrent diseases were those of the heart and blood vessels, the joints and the gastrointestinal tract, with a few having cataracts and between 5 and 6 per cent diabetes. Obesity was a factor in over 30 per cent of the cases, 6 women

* Read at the Nineteenth Annual Meeting, American Radium Society, Cleveland, Ohio, June 11–12, 1934.

with cancer of the uterus each weighed over 300 pounds, one of the group attaining a weight of 365 pounds. Many had been operated on for gallbladder disease and a large percentage were suffering occasional gallbladder colic. Ninety-five per cent suffered from constipation or some form of stomach or intestinal disease. Some of the diets taken by these patients were almost completely composed of refined carbohydrates, an occasional salad being the only normal food eaten. These carbohydrate elements were white bread, cake, cookies, biscuits, pancakes and rolls, desserts and candies. For the whole group the percentage of vitamin-containing foods fell as low in some cases as 3 per cent and in none did it rise above 25 per cent. The average for the whole group was 8.5 per cent. There were no cases of extreme single vitamin deficiencies, such as well-marked scurvy, beri-beri, or pellagra, but a large number showed the effects of rickets.

The food consumed showed universal deficiencies in calcium and iodine and iron. Apart from the examination of the foods consumed, vitamin deficiencies were shown by certain signs and symptoms. A lack of vitamin A was shown by susceptibility to colds, bronchial and sinus infections, which was bettered by a more liberal supply of whole milk, cream, butter or leafy vegetables. Vitamin B deficiency was shown by the large number of cases of constipation amenable to treatment by yeast, with concurrent increase in appetite, and the large number of mothers who failed in milk supply for their babies but who furnished sufficient milk when given a quarter to a half ounce of ordinary yeast a day. Vitamin C deficiencies were shown to be common in this group by capillary fragility and the almost universal prevalence of tooth and gum disease which was materially improved by administering a pound of orange or banana or a half pound of raw cabbage a day. Vitamin D deficiencies were shown by the evidences of rickets and tuberculosis, as checked by physical and roentgen examinations of the chest. Eighty per cent of the general population are more or less rachitic in childhood, and tuberculosis scars occur in the lungs so commonly as to be practically universal. Our patients then showed deficiencies in vitamins and minerals and also a deficiency in cellulose. These patients and their diets represented a cross section of the mid-west agricultural region, but the "bread, meat, potato, sugar diet" is more or less common to all civilized countries.

The "protectve foods" function by conferring resistance against infections. A lack of protective foods favors infections. Cancer, in every part of the body where it may be studied from its earliest beginnings, always is found to grow on an area which has been the seat of an old chronic low grade infection. It is the result of local insult to tissue which is of such a degree as would heal in a well nourished body but does not heal in an imperfectly nourished body. Cancer and diabetes have increased as the comsumption of sugar and other refined carbohydrates has increased because these refined, high calory foods have crowded out the protective foods.

Because of the lack of cellulose, which through many generations has functioned as the main stimulant to intestinal glands and intestinal peristalsis, atrophy and atony with consequent infective invasion of intestinal mucous membrane has occurred. Returning to an approximately normal cellulose intake is in some cases somewhat unpleasant, but it is important in rehabilitating these neurotic, scurvy-ridden, sugar-saturated, chronically infected patients.

In our experience the amounts ordinarily advised of vitamin-containing foods are too low for optimum results, although such amounts may protect from the more gross and extreme effects. This is well shown in Wolbach's "Vitamin A Deficiencies in Infants," where some of the children were supposed to be getting good diets but postmortem examinations showed marked evidence of vitamin deficiency. The optimum amount is in all cases several times the

minimum. Sherman has called attention to this fact in connection with the antipellagra vitamin, Hanke in connection with vitamin C, Barker and Wolbach in connection with vitamin A, and Moore of Portland in connection with vitamin B. We found the optimum requirements of vitamin A for adults to be 2 quarts of whole milk or its equivalent, for vitamin B 2 drams of dried yeast or its equivalent, for vitamin C 12 ounces of orange juice or its equivalent, and for vitamin D such an amount as may be represented by one hour of midday sun at half season or 2 drams of cod-liver oil. Unless a sufficient amount of calcium is present vitamin D is likely to prove irritating to the nervous system. If a sufficient amount of cellulose in its natural state is taken as implied under the term equivalents (in the form of fruits and vegetables), there is no room left for any refined carbohydrates. It is important that sugar and patent flour products be entirely eliminated as these furnish energy and high calories without necessary physiological concomitants, minerals, cellulose and vitamins. Table salt should also be eliminated and replaced by a mixture of salts corresponding to those in Ringer's solution.

Patients with external accessible malignancies who have followed this regimen have had 20 per cent less recurrences, have been relieved of the unpleasant effects of concurrent diseases and have enjoyed increased energy and freedom from fatigue, the most striking examples of benefit being in cases of associated arthritis, gastrointestinal troubles and obesity. It is notable in this connection that no case of carcinoma showed any material improvement until the diet was so arranged that sugar disappeared from the urine. Quoting Hoffman in the San Francisco Cancer Survey, "A large majority of tumors unquestionably arise as a result of a general factor, which I believe to be found in dietary and nutritional errors still unknown." With these facts at hand we are not giving the best service to our patients by considering only local conditions but every individual should be studied from the standpoint of the organism as a whole and all necessary dietary corrections made.

THE IONIZATION OF LIQUID CARBON DISULPHIDE BY ROENTGEN RAYS

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ABSTRACT

The ionization was measured in a layer of liquid between flat aluminum disks with spacings of 1 and 0.3 mm. Fields up to 60 kv. per cm. were used and the current voltage curve rose continuously but at a decreasing rate in this range. A plot of the reciprocal of the current against the reciprocal of the field is a straight line above 20 kv. and can be extrapolated to infinite field. The form of curve is consistent with the theory of columnar recombination and the intercept at infinite field gives the rate of production of ions. Comparison with the radiation in roentgens gives the ionization per unit volume in liquid carbon disulphide as 2,600 times that of air under standard conditions. The absorption is 1,910 times that of air and the energy of ionization per ion pair about 0.75 times that of air. The shape of the curve and the columnar theory give the diameter of the columns as 5.8×10^{-6} cm. and the density of ionization in the columns as 2.3×10^{16} ions per cm.[3]

INTRODUCTION

THE ionization of dielectric liquids by roentgen rays was discovered by Thomson[1] in 1895 and the related case of ionization by gamma rays was studied in detail by Jaffe[2] and his associates in the period 1906 to 1913. The properties of ionized liquids are comparable to very dense gases. The mobility of the ions and their rate of recombination are very small (in liquid carbon disulphide both are about 10^{-4} of the values for air at one atmosphere).[3] The current voltage curves rise rapidly toward saturation with fields up to 1,000 volts per cm. but with further increase in field the current continues to increase and in the range 1,000 to 5,000 volts the increase is nearly linear. Some of Jaffe's experiments seemed to indicate that this linear increase was absent in very pure liquids but his later papers reject this result. In a comprehensive theoretical paper[4] he was able to show that Langevin's theory of columnar recombination could account for the lack of saturation in liquids and gases ionized by alpha and gamma rays. The absorption of a quantum of roentgen rays or gamma rays gives rise to a single high speed electron. This traverses the gas or liquid, leaving a dense trail of ions, and these may be so close together that the highest fields will not separate them before some of them recombine. Insofar as the ions from separate columns do not recombine with each other the current will be proportional to the number of quanta absorbed but will be less than the total production of ion pairs. Jaffe estimated that in liquids ionized by gamma rays, only a tenth of the ions are removed from the column while with alpha-ray tracks only one in a thousand escapes. These estimates are based on the assumption that the average energy expended per ion pair is the same as in air. Published results obtained with fields of less than 5,000 volts per cm. give no basis for an experimental value of the actual number of ions produced in a liquid. It has been our purpose to extend current voltage curves to much higher fields in an attempt to measure the actual production of ions by roentgen rays in liquids. Jaffe's results and our preliminary experiments indicated that carbon disulphide was a promising liquid for the experiment.

IONIZATION CHAMBERS

The attainment of high fields requires smooth, rounded surfaces close together and we have used a simple two-electrode

[1] Thomson, J. J. *Nature*, 1895, *53*, 378.
[2] Jaffe. *Ann. d. Phys.*, 1908, *25*, 257; 1909, *28*, 326.
[3] Van der Biji. *Ann. d. Phys.*, 1912, *39*, 170.
[4] Jaffe. *Ann. d. Phys.*, 1913, *42*, 303.

chamber sealed in a pyrex bulb, as illustrated in Figure 1. The electrodes are aluminum disks 4.5 cm. in diameter with the edges rounded. Plate separations of 1 mm. and 0.3 mm. were used. This bulb construction is adapted to obtaining pure dry liquid in the chamber but it was not possible to evaluate accurately the radiation flux through the end of the bulb.

For quantitative comparison of liquid and air ionization the following chamber was made. Two plates of aluminum were separated by mica rings of 8 cm. outside diameter and 4 cm. inside diameter. These rested in a crystallizing dish. A mica cover limited evaporation and a lead ring restricted the vertical roentgen beam to the 4 cm. hole in the mica spacers. Here the radiation flux could be accurately estimated and the ionized volume of liquid is not subject to edge corrections.

PURIFICATION OF LIQUID

Commercial carbon disulphide has a high conductivity and must be purified. The conducting impurities are probably water and hydrogen sulphide. The procedure was to pour the liquid into a bulb containing quick lime and hold it at liquid air temperature in high vacuum while baking out the ionization chamber. Then the liquid was slowly distilled in vacuum through phosphorus pentoxide into a trap, and finally into the ionization chamber. The resulting liquid had a specific resistance of more than 10^{14} ohms. This gives a leak of less than 1 per cent of the ionization current but very much higher resistance can be obtained with elaborate precautions.[5] In using the open chamber this was first dried by warming and the purified liquid poured in. The leak here was about 10 times that in the vacuum chamber though the experiments were made in cold dry winter weather.

RADIATION

Slightly filtered roentgen rays from a tungsten target tube operated at 120 kv. constant potential, and a current of 5 ma. or less, passed through the chamber normal to the electrodes at a distance of about 50 cm. from the target. The ionization in the liquid was compared with air ionization by replacing the chamber by a roentgenometer calibrated to read in roentgens for the quality of radiation used. The quality of radiation expressed in terms of the true effective wave length in aluminum was 0.44 Å outside the chamber and 0.27 Å in the liquid.[6]

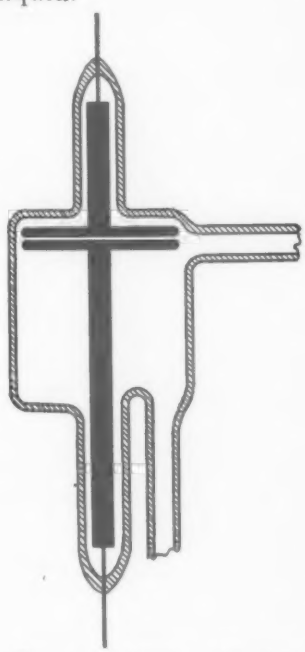

Fig. 1. Ionization chamber.

The ionization in a small chamber depends on the wall material as well as the ionized medium. For carbon disulphide and aluminum the effect is small for both have comparable roentgen-ray absorption so that the loss of electrons by the liquid nearly compensates for the gain from the metal. Taking the difference in ionization with different electrode spacings should eliminate the wall effect but because of the increased experimental error this procedure was not used.

[5] Van der Bijl. *Ann. d. Phys.*, 1912, *39*, 170.

[6] The roentgen is the quantity of radiation which will give in 0.001293 g of air one e.s.u. of ion pairs. The true effective wave length is the wave length of homogeneous radiation which will be reduced in the same ratio by an infinitesimal layer of aluminum. In media comparable with aluminum in atomic number (and only in these) the radiation can be treated as a homogeneous radiation of this wave length. (Taylor, L. S. *Bur. Standards J. Research*, 1930, *5*, 517.)

ELECTRICAL MEASUREMENTS

The voltage source for the ionization chamber was a very steady constant potential roentgen-ray generator. The leads to the chamber were covered and shielded to avoid corona and air ionization. Currents were of a magnitude to measure with a sensitive galvanometer. The response upon admitting or cutting off the radiation was nearly instantaneous but the dark current dropped at a decreasing rate for minutes every time the voltage was increased. This comes in part from electrical clean up of the liquid and in part from polarization.

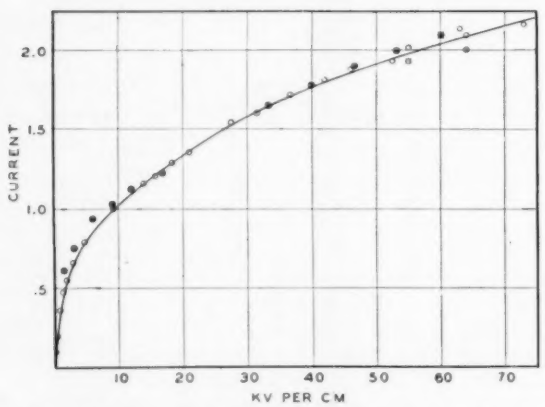

FIG. 2. Current voltage curve in liquid carbon disulphide. Circles with 1 mm. between electrodes, crosses 0.3 mm.

With fields up to 20 or 30 kv. per cm. the dark current is small. At higher fields it rapidly becomes large and unsteady, and above 60 kv. the measurements are too inaccurate to be useful. The maximum field strength was about the same for plate separations of 1 mm. or 0.3 mm. for dry liquid in vacuum and for the liquid exposed to air.

THE CURRENT VOLTAGE CURVE

All results reduced to the same current scale are included in Figure 2. Open circles give measurements with a 1 mm. spacing and crosses apply to the 0.3 mm. spacing with a current correspondingly smaller. Tests with different intensities of radiation showed that above 2 kv. per cm. the current is proportional to the intensity. Hence we conclude that above this point the form of the curve is not influenced by intercolumnar recombination. This result does not support the view that traces of impurity modify the form of the curve.[7]

Jaffe[8] has derived a general expression for the fraction of ions I_X/I_∞ drawn from a column by a field X when the ion pairs are initially distributed in a cylinder of diameter d with a density of N pairs per cm. of column length.

$$\frac{I_\infty}{I_X} = 1 + \frac{\alpha N}{7.85\, d\, u X\, F(X)} \qquad (1)$$

Here α is the recombination coefficient, 9×10^{-10} and u the mobility of the ions,

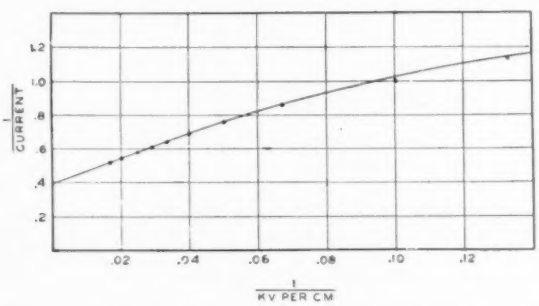

FIG. 3. Curve of Figure 2 plotted with reciprocal of current versus reciprocal of voltage.

0.66×10^{-3} cm. per sec. per volt per cm. $F(X)$ is a complicated function which approaches 1 for high fields (over 10^4 volts per cm.). The form of the equation indicates that a plot of $1/I_X$ versus $1/X$ will be nearly linear.

Figure 3 gives the curve of Figure 2 on this scale and the resulting curve conforms to the theoretical prediction. In view of the theory, it is safe to make a linear extrapolation from the observed points to $1/X=0$. The intercept gives (in arbitrary units) the reciprocal of the current at infinite voltage and is a measure of the actual rate of production of ions by the roentgen rays. Measurements at the highest fields gave about three-quarters of the saturation current.

[7] Jaffe. *Ann. d. Phys.*, 1909, *28*, 326.
[8] Jaffe. *Ann. d. Phys.*, 1913, *42*, 303.

COMPARISON WITH AIR IONIZATION

The ionization produced in the open chamber with 1 mm. spacing was compared with the reading of the roentgenometer. The radiation flux corrected for absorption in the top plate of the liquid chamber was 0.129 roentgens per sec. (0.129 e.s.u. per cm.^{3} of free air under standard conditions). The current in the liquid extrapolated to infinite field was 1.12×10^{-7} amp. per cm.^{3} or 336 e.s.u. per cm.^{3} per sec. Hence the ionization per unit volume in liquid carbon disulphide is 2,600 times that in air.

The ionization in any medium is proportional to the energy absorbed, divided by the average energy required to produce an ion pair, or $\mu\rho/E$, where μ is the mass absorption coefficient, the density, and E the energy per ion pair. Thus

$$\frac{(\mu\rho/E) \text{ for } CS_1}{(\mu\rho/E) \text{ for air}} = 2{,}600.$$

The experimental value[9] of μ for air for radiation of this quality is 0.33. The value μ for CS_2 computed from the monochromatic values for C and S at 0.27 Å (the effective wave length in Al for the radiator) is 0.67. The density ratio is 1,000. Taking the average energy expended per ion pair in air as 33 electron volts, we find the average energy in liquid carbon disulphide is 24 volts. A published value[10] of the ionization of carbon disulphide vapor by roentgen rays indicates a value of 26 electron volts. We conclude that within the range of experimental uncertainty the energy required to ionize carbon disulphide is the same in the liquid phase as in the gas phase.

COLUMNAR IONIZATION

As noted above, the process of ionization consists in the ejection of a high speed electron which traverses the liquid and produces a dense column of ions. On the basis of our experimental data and Jaffe's theory the process can be described in more detail. The secondary electrons will have an average energy of 46,000 electron volts (corresponding to 0.27 Å). These will go a distance of 3.2×10^{-3} cm. through the liquid[11] and produce in this distance 1,900 ion pairs giving an average density of 6×10^5 pairs, per cm. of path. At high voltages equation 1 becomes

$$\frac{I_\infty - I_X}{I_X} = \frac{\alpha N}{7.85\, d\, u\, X}$$

where N is the ion density evaluated above and all other quantities are known except d, the diameter of the column. The slope of the curve in Figure 3 gives the value of d as 5.8×10^{-6} cm. (The distance between ion pairs $(1/N)$ is 1.7×10^{-6} cm.). The physical significance of d is probably as follows: The secondary electrons produce positive ions and tertiary electrons of about 10 volts energy which move away until they become attached to molecules to form heavy negative ions. The constant d is (apart from a small geometrical factor) the distance the electron goes before attaching. This distance is a characteristic of the liquid and an important but unpredictable factor in determining the yield of ions under a given field.

The values for the dimensions of a column lead to a value of 2.3×10^{16} ion pairs per cm.^{3} in a column. From the recombination equation in the form

$$\frac{1}{n} - \frac{1}{n_0} = \alpha t$$

it is found that this ionization will be reduced to a fifth of its initial value in 2×10^{-7} sec. About a fifth of the ions escape in zero field so this time is the life of the column. In our experiment roentgen-ray quanta were absorbed and columns produced at the rate of 3.7×10^8 per cm.^{3} per sec. Thus, about 74 columns per cm.^{3} existed at any instant. From the conductivity produced by roentgen rays at low voltage and the mobility of the ions one

[9] Taylor, L. S. *Bur. Standards J. Research*, 1931, *6*, 219.

[10] Thomson, J. J. Conduction of Electricity in Gases. 1933, Vol. 2, p. 238.

[11] Rutherford, Chadwick and Ellis. Radiations from Radioactive Substances. Cambridge University Press, 1930, p. 422.

estimates the average concentration of ion pairs in zero field as 1.1×10^{10} per cm.[3] Upon cutting off the radiation this will drop to half-value by recombination in 0.2 sec.

CONCLUSIONS

The above numerical values for the elementary processes are of interest only as an illustration of the deductions that can be drawn from the constants of the current voltage curve. The results support the assumption that the number of ions produced in a liquid by the absorption of a quantum is about the same as in a gas and that the current resulting from the ionization is greatly reduced by intracolumnar recombination.

The application of liquid ionization chambers to the measurement of roentgen rays and gamma rays is not new but its possibilities are not generally appreciated.[12] With fields of the order of 20 kv. per cm. the current in carbon disulphide is perfectly steady and strictly proportional to the intensity and it is over 1,000 times the current from an equal volume of air. The comparison of radiations of different quality would require further research. The columnar recombination theory indicates that the degree of saturation for a given field will depend on the quality because of the variation in the number of ions per unit length of the column.

[12] Stahel. *Strahlentherapie*, 1929, *31*, 582.

Vol. 34, No. 1

A NOTE ON BACTERICIDAL EFFECTS OF ROENTGEN RAYS

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ABSTRACT

The effects of roentgen rays in liquids are localized in columns of ionization along the path of each high speed electron. It is assumed that biological effects are produced in these volumes, and experimental results of Wyckoff and Rivers on killing of colon bacilli by cathode rays and roentgen rays are expressed in terms of the effective collision area of the column and bacillus for killing. Cathode rays of 155 kv. give an area of 0.68×10^{-10} cm^2. Roentgen rays of wave lengths ranging from 0.56 Å to 4 Å give values between 0.72×10^{-10} and 2.6×10^{-10} cm^2. As the area of the bacillus is about 10^{-8} cm.^{2}, passage of a column through the bacillus is in general not fatal. The column must pass through a particular point to cause death.

WHEN a roentgen ray is absorbed by matter, the entire energy of the roentgenray quantum is given to a single electron. This high speed secondary electron traverses the medium and produces a dense path of ion pairs. The energy of the secondary electron is related to the wave length of the roentgen rays by the quantum relation.

$$V(\text{electron volts}) = 12340/\lambda(\text{Ångströms}). \quad (1)$$

The number of ion pairs in air is about $V/35$. The length x of the electron path depends on the density of the medium and is given with fair approximation by the relation[1]

$$x\rho = v^4/.505 \times 10^{43} \quad (2)$$

where ρ is the density and v the electron velocity. The path is crooked and the average distance the electron goes is less than x. These general relations should be applicable to liquids and solids as well as gases. In a medium of density one, the electron path will be reduced to about 1/800 of its value in air and the ion density will be correspondingly greater. Experiments[2] on the ionization of liquid carbon disulphide by roentgen rays (effective wave length 0.27 Å) have given roughly quantitative information concerning these columns of ionization. The number of ions produced per quantum in the liquid is about the same as in the gaseous phase. The volume ionized by each quantum is equal to a cylinder of length equal to the electron path (3×10^{-3} cm.) and of cross section 0.28×10^{-10} cm.^{2} This dense column of ionization disappears by recombination in less than a millionth of a second and only a small fraction of the ions diffuse into the surrounding medium.

It is attractive to assume that biological effects of roentgen rays are produced exclusively in these columns of ionization and that the chance of producing a given effect on a cell depends on the chance of a column passing either through the cell or through a particular part of the cell. This view is not new. Wyckoff[3] has discussed his experimental results on destruction of bacteria by roentgen rays in these terms. His computations are, however, made on a somewhat different basis. In the following, we will treat his results from a purely columnar viewpoint.

Experiments on the destruction of bacteria by cathode rays of 155 kv. were made by Wyckoff and Rivers.[4] Separate bacteria spread on a surface of agar, were exposed to a beam of cathode rays of measured intensity and the fraction surviving after a time, t, was determined by counting the clusters developed after an incubation period. They show that this survival ratio

[1] Compton, A. H. X-Rays and Electrons, 1928, p. 256.

[2] Mohler, F. L., and Taylor, L. S. *Nat'l Bur. Standards J. Research.*

[3] Wyckoff, R. W. G. Killing of certain bacteria by x-rays. *J. Exper. Med.*, 1930, *52*, 435–446.

[4] Wyckoff, R. W. G., and Rivers, T. M. Effect of cathode rays upon certain bacteria. *J. Exper. Med.*, 1930, *51*, 921–932.

is given by the relation

$$A(t)/A_0 = e^{-at} = e^{-bnt} \qquad (3)$$

where n is the number of cathode rays per cm.^{2} per sec. and b gives the fraction of bacteria killed per cathode ray and a the fraction per second. As they point out, this exponential relation is consistent with the view that killing depends simply on the cathode ray striking a given area in the bacillus. Consider this area, σ, associated with the cathode ray. Then an area a of equation 3 determined from measurements of survival ratios. The energy of the secondary electrons in electron volts (eq. 1) divided by 35 gives the number of ion pairs produced per quantum, and from the measured air ionization is derived the number of quanta absorbed in air per cm.^{3} per sec. The rate of absorption of quanta and production of columns, n, in the agar is taken to be 780 times this. The volume sterilized by each column is σx where x is given by equation 2 and $n\sigma x$ is the volume

TABLE I

KILLING OF COLON BACILLI BY ROENTGEN RAYS

Radiation	λ(Å)	Energy of Electrons (kv.)	Range of Electrons (cm.)	Quanta Absorbed in Agar (per sec. per cm.^{3})	Rate of Killing (a)	Effective Area (cm.^{2})
Ag K	0.564	22.0	1.2×10^{-3}	1.9×10^{11}	0.0174	0.76×10^{-10}
Mo K	0.710	17.4	0.75×10^{-3}	3.1×10^{11}	0.0167	0.72×10^{-10}
Cu K	1.537	8.0	1.6×10^{-4}	12.4×10^{11}	0.0370	1.9×10^{-10}
Cr K	2.29	5.4	0.72×10^{-4}	29×10^{11}	0.0413	2.0×10^{-10}
Ag L	3.98	3.1	2.4×10^{-5}	25×10^{11}	0.0159	2.6×10^{-10}
Cathode rays	—	155.0	1.8×10^{-2}	—	—	0.68×10^{-10}

$n\sigma$ is sterilized when n rays pass through the surface and we see that σ is to be identified with the constant b. In their experiments with colon bacilli a current of 1.65×10^9 electrons per second gave a value of a of 0.112 per sec. Hence $\sigma = 0.68 \times 10^{-10}$ cm.^{2} Their experiments with *Bacillus aertrycke* gave an identical effective area. *Staphylococcus aureus* gave an area half as great. The colon bacillus is a rod about 2×10^{-4} cm. long and 0.5×10^{-4} cm. in diameter and hence has a cross section of about 10^{-8} cm.^{2} in any direction. The fatal area is very much smaller than the area of the bacillus.

Wyckoff[5] carried out comparable experiments on the destruction of colon bacilli by roentgen rays of different wave lengths. The roentgen rays were predominantly the characteristic radiations listed in Table 1. The experimental data are the air ionization in roentgens per sec. and the constant sterilized per sec. which is equated to the constant a of equation 3. The last column of Table 1 gives the computed values of σ for the different radiations. The physical basis for these computations becomes uncertain for the longest wave lengths since equation 2 giving the range x has not been tested in this range.

The important conclusion from these computations is that the effective area is nearly the same for cathode rays and secondary electrons produced by roentgen rays and that this area is very much smaller than the cross section of a bacillus. On the view that there is a sensitive spot in the bacillus through which the column of ionization must pass, the effective area may be expressed as

$$\sigma = \pi(a_1 + a_2)^2$$

where a_1 is the radius of the column and a_2 the radius of the spot. The experimental values of σ are of the same magnitude as the cross section of the column of ioniza-

[5] Wyckoff, R. W. G. Killing of colon bacilli by x-rays of different wave lengths. *J. Exper. Med.*, 1930, *52*, 769–780.

tion computed for the particular case of CS_2 ionized by roentgen rays. If the columns in agar are of comparable size the area of the hypothetical spot may be indefinitely less than σ.

Wyckoff has expressed the effectiveness of both cathode rays and roentgen rays in terms of the fraction absorbed by a single bacillus. From a purely columnar viewpoint the absorption does not enter at all in evaluating the effectiveness of cathode rays; while in the case of roentgen rays it is the absorption coefficient of the bacillus and of the surrounding medium which is significant. However, in the present state of knowledge there is little question of right or wrong in either viewpoint.

The density of ionization in a column decreases with increasing speed of the electron and is nearly 15 times as great for the Ag L secondaries as for the 155 kv. cathode rays. If the effectiveness of roentgen rays depended solely on the volume of the columns of ionization, then σ would remain constant and the effect per roentgen would decrease with increasing wave lengths. For Wyckoff's experimental data, the values of σ increase somewhat with increasing wave length and the effect per roentgen decreases but not as much as for a pure volume effect. It is doubtful whether this variation in σ is significant; it is certain that no general conclusion as to biological effectiveness of roentgen rays can be drawn from a single series of experiments.

Although σ may be expected to vary with the biological material and the quality of the radiation, nevertheless the columnar viewpoint seems to offer a logical starting point for theory. The known physical effects of roentgen rays in liquids and solids are limited to the columns of ionization produced by high speed electrons. The numerical value of σ is a convenient expression for the bactericidal effectiveness of the columns whether or not one takes the view that killing depends on striking a certain spot in the cell.

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Thirty-sixth Annual Meeting: Atlantic City, N.J., Sept. 24–27, 1935.

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President: George W. Grier, Pittsburgh, Pa.; *President-Elect:* Zoe H. Johnston, Pittsburgh, Pa.; *1st Vice-President:* George M. Dorrance, Philadelphia, Pa.; *2d Vice-President:* James J. Duffy, New York City; *Secretary:* E. H. Skinner, 1532 Professional Bldg., Kansas City, Mo.; *Treasurer:* Lawrence A. Pomeroy, Osborn Bldg., Cleveland, Ohio.

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Janeway Lecture Committee: Douglas Quick, Chairman, New York City.

Committee on Arrangements: E. H. Skinner, Chairman, Kansas City, Mo., E. K. Robinson, Kansas City, Mo., W. R. Brooksher, Fort Smith, Ark.

Twenty-first Annual Meeting: Kansas City, Mo., May 11–12, 1936.

EDITORIAL

POSTERIOR DISPLACEMENT OF THE FIFTH LUMBAR VERTEBRA: AN OPTICAL ILLUSION

NO PART of the human skeleton has provoked more controversy and discussion than the lumbosacral joint. The prevalence of low back and sciatic pain is one explanation for the enormous literature that has accumulated and the multiplicity of the etiological factors advanced as the causation of this pain has undoubtedly stimulated discussion. Added to this, the ease and facility with which the lumbosacral joint can be demonstrated since the advent of the Potter-Bucky diaphragm, it is little wonder that this area has been a fertile field of investigation.

The variety of explanations offered as the causative factor in lumbosacral pain is evidence of a lack of any single theory which would explain this clinical syndrome. Spontaneous spondylolisthesis has for a long time been known and the part that it plays in low back pain has been generally recognized. But until comparatively recently the question of posterior displacement of the fifth lumbar on the first sacral segment had not been advanced as one of the causative factors in low back and sciatic pain.

Johnson[1] and Smith[2] independently have called attention to the possibility of posterior luxations of the lumbosacral joint. Johnson discusses what he considers a slight slipping of the body of the fifth lumbar backward so that the posterior border of the body can be seen to overhang the top of the first sacral body by about one-half centimeter in an accurately focused lateral roentgenogram. The articular facets of the fifth lumbar vertebra seem to be displaced downward and posteriorly, which would decrease the fifth lumbar intervertebral foramen and this would seem to be one of the factors in the production of symptoms. He says that the intervertebral disc may or may not be flattened or irregular, and the question of the integrity of the nucleus pulposus cannot be determined in all cases by roentgen examination, but seems to be inconstant. The lumbosacral angle is also inconstant, being invariably increased, normal, or decreased. He reports a group of cases whose symptomatology and the roentgen-ray findings would point definitely to a posterior dislocation of the fifth lumbar on the first sacral segment. The analysis of these cases confirmed his belief that this posterior displacement of the fifth lumbar on the first sacral segment is a "genuine type of subluxation and not an artefact of roentgenography." He also calls attention to the fact that while the posterior subluxation is less dramatic in appearance than spondylolisthesis, it is apparently far more common and must play a fairly important rôle in that heterogeneous mob called "low-back strains."

Smith, in an independent report on posterior displacement of the fifth lumbar vertebra, based his study upon fifty-six cases. The male patients predominated in his group, there being thirty-six males and twenty females, and the average age at which they presented themselves for treatment was thirty-one and six-tenths years, but the average age at which the symptoms began was twenty-nine years. He says that unquestionably the most important single factor in determining a posterior displacement is the structure of the lateral articulations between the fifth lumbar and first sacral vertebrae. Trauma, he says, plays

[1] Johnson, R. W., Jr., Posterior luxations of the lumbosacral joint. *J. Bone & Joint Surg.*, 1934, *16*, 867–876.

[2] Smith. A. deF. Posterior displacement of the fifth lumbar vertebra. *J. Bone & Joint Surg.*, 1934, *16*, 877–888.

but a secondary rôle and can cause such a displacement only if a certain mechanical setup is present. The posterior displacement is not necessarily great. As measured in lateral roentgenograms the displacement was two-sixteenths of an inch in nine cases; three-sixteenths of an inch in twenty-three; four-sixteenths of an inch in eighteen; five-sixteenths of an inch in one and seven-sixteenths of an inch in one. Both Johnson and Smith emphasize the necessity of direct lateral roentgenograms in visualizing this posterior displacement. In all of Smith's patients pain was the outstanding symptom, being present in fifty-two of the fifty-six patients, and in the majority was severe, prolonged and disabling. One of the striking characteristic features of the symptomatology in his cases was the radiation of pain along part or the whole of the sciatic distribution and this pain Smith believed to be due to pressure upon the fifth lumbar root in the canal formed by the pedicles and the lateral articulation. He says that the decisive and most important factor in the diagnosis lies in the roentgenographic examination which must include a "good lateral view which is taken exactly in the lateral plane," a slight shift of the tube being enough to produce the appearance of a posterior displacement when none exists or to conceal the presence of one. He concludes from the analysis of this group of cases that posterior displacement occurs frequently and is an important cause of severe back pain and that this displacement happens as a result of an anatomical variation in the facets of the lateral articulations between the fifth lumbar and first sacral vertebrae.

Willis,[3] on the contrary, in an analysis of the illustrations given by Johnson and Smith in support of their theory of posterior displacement of the fifth lumbar as one of the factors in low back pain, came to the conclusion that the fifth lumbar vertebra "subluxating up the steeply inclined surface of the sacrum" is an optical illusion and that a measurement of the opposed lumbar and sacral surfaces in these illustrations reveals the secret of the illusion. His measurements would indicate that in every instance the anteroposterior diameter of the sacrum is less than that of the last lumbar segment. While the anterior borders are in alignment, the posterior borders overlap.

In order to prove whether or not there is a normal difference in depth of the opposing lumbar and sacral articular surfaces he measured fifty consecutive skeletons in the Hamann Museum and of these fifty skeletons only in seventeen were they found equal. In thirty-three the anteroposterior diameter of the sacral surface was from one to four-sixteenths of an inch less than that of the opposing lumbar surface, and in analyzing these surfaces he showed the difference in the anteroposterior depth to be due to the conformation of the posterior borders of the sacral surfaces. These varied from convexity to concavity toward the neural canal, while the posterior lumbar borders were regularly convex and that therefore the illusion of the posterior displacement of the lumbar segment can be attributed to relative shortening in the anteroposterior diameter of the first sacral segment. In twelve patients of Johnson's report the displacement varied from less than one-eighth of an inch to slightly more than one-fourth of an inch and Johnson advanced the thought that the condition exists in at least 10 per cent of patients with low back symptoms, while Smith found the overlap to vary from one-eighth to one-fourth of an inch except in two patients where it was respectively five-sixteenths and seven-sixteenths of an inch. Smith concluded that posterior displacement of the fifth lumbar occurs frequently.

Willis, in an analysis of the skeletons, found that the diameters of the lumbar and sacral segments were equal in seventeen. In the remaining thirty-three, or 66 per cent, the sacral diameters were from one-sixteenth to one-fourth of an inch shorter

[3] Willis, T. A. Backward displacement of the fifth lumbar vertebra: an optical illusion. *J. Bone & Joint Surg.*, April, 1935, *17*, 347–352.

than the lumbar, four of them reaching the latter figure, and he concludes that careful measurement of the bones in these unselected skeletons demonstrates a difference in the anteroposterior diameter six times as frequently as does the lateral roentgenogram in patients having back symptoms. Willis says that as a rule the first sacral segment is convex posteriorly, but less so than the last lumbar. The second and lower sacral segments are usually concave. In some individuals the first sacral presents this characteristic of the second; in such a condition it is another of those lumbosacral anomalies associated with numerical variation of the vertebrae. Because it is found no more frequently in painful backs than in museum skeletons it is probably of no clinical importance, and is certainly not to be considered a displacement and that so-called backward displacement of the fifth lumbar vertebra is an optical illusion.

Whatever may be the causative factors given as an explanation for lumbosacral or sciatic pain, it may be concluded from Willis' study that posterior displacement of the fifth lumbar on the first sacral segment should not be included among them.

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this section solicited promptly after the events to which they refer.

MEETINGS OF ROENTGEN SOCIETIES*

UNITED STATES OF AMERICA

AMERICAN ROENTGEN RAY SOCIETY
Secretary, Dr. E. P. Pendergrass, University Hospital, Philadelphia, Pa. Annual Meeting: Atlantic City, N. J., Sept. 24–27, 1935.

AMERICAN COLLEGE OF RADIOLOGY
Secretary, Dr. B. H. Orndoff, 2561 N. Clark Street, Chicago, Ill. Annual meeting: Kansas City, Mo., 1936.

SECTION ON RADIOLOGY, AMERICAN MEDICAL ASSOCIATION
Secretary, Dr. J. T. Murphy, 421 Michigan St., Toledo, Ohio. Annual meeting: Kansas City, Mo., 1936.

RADIOLOGICAL SOCIETY OF NORTH AMERICA
Secretary, Dr. D. S. Childs, 607 Medical Arts Bldg., Syracuse, N.Y. Annual meeting: Detroit, Mich., Dec. 2–6, 1935.

RADIOLOGICAL SECTION, BALTIMORE CITY MEDICAL SOCIETY
Secretary, Dr. W. B. Firor, 1100 N. Charles St., Baltimore. Meets third Tuesday each month, September to May.

RADIOLOGICAL SECTION, LOS ANGELES COUNTY MEDICAL SOCIETY
Secretary, E. N. Liljedahl, Los Angeles, Calif. Meets on the fourth Wednesday of each month at the California Hospital.

RADIOLOGICAL SECTION, SOUTHERN MEDICAL ASSOCIATION
Secretary, Dr. H. J. Walton, 104 W. Madison St., Baltimore, Md. Annual meeting, St. Louis, Mo., Nov. 19–22, 1935.

BROOKLYN ROENTGEN RAY SOCIETY
Secretary, Dr. E. Mendelson, 120 E. 19th St., Brooklyn, N.Y. Meets monthly on first Tuesday, October to April.

BUFFALO RADIOLOGICAL SOCIETY
Secretary-Treasurer, Dr. Joseph S. Gian-Franceschi, 610 Niagara St., Buffalo, N.Y. Meets second Monday of each month except during summer months, place of meeting selected by the host.

CHICAGO ROENTGEN SOCIETY
Secretary, Dr. R. G. Willy, 1138 N. Leavitt. Meets second Thursday of each month October to May inclusive at the Palmer House.

CINCINNATI RADIOLOGICAL SOCIETY
Secretary, Dr. H. G. Reineke, General Hospital, Cincinnati, Ohio. Meets third Monday of each month, October to May, inclusive.

CLEVELAND RADIOLOGICAL SOCIETY
Secretary, Dr. Otto Glasser, Cleveland Clinic. Meetings are held at 6:30 P.M. at the Cleveland Chamber of Commerce Club rooms on the fourth Monday of each month from October to April, inclusive.

DENVER RADIOLOGICAL CLUB
Secretary, Dr. K. D. A. Allen, 452 Metropolitan Building, Denver, Colorado. Meets on any month having a fifth Monday.

DETROIT ROENTGEN RAY AND RADIUM SOCIETY
Secretary, Dr. E. R. Witwer, Harper Hospital. Meets monthly on first Thursday from October to May, at Wayne Country Medical Society Building.

FLORIDA STATE RADIOLOGICAL SOCIETY
Secretary, Dr. Gerard Raap, Miami, Florida. Meetings held twice a year, May and November.

ILLINOIS RADIOLOGICAL SOCIETY
Secretary, Dr. H. W. Grote, 219 N. Main St., Bloomington, Ill. Regular meetings held quarterly.

INDIANA ROENTGEN SOCIETY
Secretary, Dr. J. N. Collins, Indianapolis, Ind. Meeting held the second Sunday in May annually.

LONG ISLAND RADIOLOGICAL SOCIETY
Secretary, Dr. M. Dannenberg, 1464 Eastern Parkway, Brooklyn, N. Y. Meets on third Thursday of each month from October to May, at 8:30 P.M.

MICHIGAN ASSOCIATION OF ROENTGENOLOGISTS
Secretary, Dr. S. W. Donaldson, St. Joseph's Mercy Hospital, Ann Arbor, Mich. Three meetings a year, Fall, Winter, and Spring.

MILWAUKEE ROENTGEN RAY SOCIETY
Secretary, Dr. S. A. Morton, Columbia Hospital, Milwaukee, Wis. Meets monthly. Place of meeting designed by the president.

MINNESOTA RADIOLOGICAL SOCIETY
Secretary, Dr. L. G. Rigler, University Hospital, Minneapolis, Minn.

NEW ENGLAND ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas R. Healy, 370 Marlboro St., Boston, Mass. Meets monthly on third Friday, Boston Medical Library.

RADIOLOGICAL SOCIETY OF NEW JERSEY
Secretary, Dr. P. S. Avery, New Brunswick, N. J. Meets annually at time and place of State Medical Society. Mid-year meetings at place designated by the president.

NEW YORK ROENTGEN SOCIETY
Secretary, Dr. E. F. Merrill, 30 W. 59th St., New York. Meets monthly on third Monday, New York Academy of Medicine, at 8:00 P.M.

NORTH CAROLINA ROENTGEN RAY SOCIETY
Secretary, Dr. Major Fleming, Rocky Mount, N. C. Annual meeting at time and place of State Medical Society. Mid-year scientific meeting at place designated.

CENTRAL NEW YORK ROENTGEN RAY SOCIETY
Secretary, Dr. C. F. Potter, 820 S. Crouse Ave., Syracuse, N.Y. Three meetings a year—January, May, and November.

PACIFIC ROENTGEN CLUB
Secretary, Dr. L. H. Garland, 450 Sutter St., San Francisco, Calif. Meets annually, during meeting of California Medical Association

PENNSYLVANIA RADIOLOGICAL SOCIETY
Secretary, Dr. L. E. Wurster, Williamsport, Pa.

PHILADELPHIA ROENTGEN RAY SOCIETY
Secretary, Dr. Thomas Loughery, Germantown Hospital. Meeting first Thursday of each month from October to May inclusive, at 8:15 P.M., in Thompson Hall, College of Physicians, 19 S. 22d St.

ROCHESTER ROENTGEN RAY SOCIETY, ROCHESTER, N.Y.
Secretary, Dr. W. W. Fray, Strong Memorial Hospital. Meets monthly on second Thursday from October to May, inclusive, at 7:45 at the Rochester Medical Association Building.

ST. LOUIS ROENTGEN RAY SOCIETY
Secretary, Dr. P. C. Schnoebelen, Missouri Bldg., St. Louis, Mo. Meets first week of each month. Time and place of meetings designated by president.

SOUTH CAROLINA X-RAY SOCIETY
Secretary, Dr. R. B. Taft, 105 Rutledge Ave., Charleston. Meets at time and place of South Carolina State Medical Association.

TENNESSEE RADIOLOGICAL SOCIETY
Secretary, Dr. F. B. Bogart, 311 Medical Arts Bldg.

* Secretaries of Societies not here listed are requested to send the necessary information to the Editor.

Chattanooga, Tenn. Meets annually at the time and place of the Tennessee State Medical Association.

Texas Radiological Society
Secretary-Treasurer, Dr. J. H. Smith, Lubbock, Texas. Meets annually one day preceding the meeting of the Texas State Medical Association.

University of Michigan Department of Roentgenology Staff Meeting
Secretary, Dr C. B. Peirce, University Hospital, Ann Arbor, Mich.
Meets each Monday evening from September to June, at 7 P.M. at University Hospital.

University of Wisconsin Roentgen Club
Secretary, Dr. E. A. Pohle, 1300 University Ave., Madison, Wis.
Meets monthly on last Thursday, October to April, Service Memorial Institute, at 4:30 P.M.

Virginia Roentgen Ray Club
Secretary, Dr. V. W. Archer, University Hospital, University, Va.
Meets annually in October.

Cuba

Sociedad Cubana de Radiologia y Fisioterapia
Secretary, Dr. Francisco Padron, Enrique, Villuendas 64, Havana, Cuba. Meets monthly in Havana.

British Empire

British Institute of Radiology Incorporated with the Röntgen Society
Meets on the third Thursday of each month, from November to June inclusive, at 8:15 P.M., at 32 Welbeck St., London, W. 1, or as advertised.

Electro-Therapeutic Section of the Royal Society of Medicine (Confined to Medical Members)
Meets on the third Friday of each month during the winter at 8:30 P.M. at the Royal Society of Medicine, 1 Wimpole St., London, W. 1.

Section of Radiology and Medical Electricity, Australasian Medical Congress
Secretary, Dr. H. M. Cutler, 139 Macquarie St., Sydney, New South Wales.

Radiological Section of the Victorian Branch of the British Medical Association
Secretary, Dr. Colin Macdonald, Lister House, 61 Collins St., Melbourne, Australia.
Meets monthly at Melbourne during the winter.

Section on Radiology, Canadian Medical Association
Secretary, Dr. A. H. Rolph, 160 St. George St., Toronto, Ont.

Radiological Section, New Zealand British Medical Association
Secretary, Dr. P. C. Fenwick, The Hospital, Christchurch. Meets annually.

Continental Europe

Belgian Society of Roentgenology
Secretary, Dr. j. Boine, Avenue des Alliés, 134, Louvain (Belgium).
Meets monthly on second Sunday at d'Egmonds Palace, Brussels, except in the summertime.

Société de Radiologie Médicale de France
Meets monthly on second Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Société Suisse de Radiologie (Schweizerische Röntgen-Gesellschaft)
Secretary for French language, Dr. A. Grosjean, La Chaux de Fonds.
Secretary for German language, Dr. Scheurer, Molzgasse, Biel.
Meets annually in different cities.

Société Francaise d'Electrothérapie et de Radiologie Médicale.
Meets monthly on fourth Tuesday, except during months of August and September, 12 Rue de Seine, Paris.

Association of German Roentgenologists and Radiologists in Czecho-Slovakia
Secretary, Dr. Walter Altschul, German University, Prague, 11.52.

Deutsche Röntgen-Gesellschaft (Gesellschaft für Röntgenkunde und Strahlenforschung)
Meets annually in April, alternating one year in Berlin, one year in some other German city. Meets in addition every two years with the Gesellschaft deutscher Naturforscher und Aerzte.
Permanent secretary, Professor Dr. Haenisch, Klopstockstrasse 10, Hamburg, Germany.

Süd- und Westdeutsche Röntgengesellschaft
Meets annually in different cities.

Nord- und Ostdeutsche Röntgengesellschaft
Meets annually in different cities.

Dutch Society of Electrology and Roentgenology
Holds two meetings a year in Amsterdam, one in the Spring, and one in the Fall.

Societa Italiana Radiologia Medica
Secretary, Professor M. Ponzio, University of Turin, Turin.

Societatea Romana de Radiologie si Electrologie
Secretary, Dr. Virgil Ionescu, B-dul Schitu Măgureanu 49, Bucarest.
Meets second Monday in every month with the exception of July and August.

All-Russian Roentgen Ray Association, Leningrad, USSR in the State Institute of Roentgenology and Radiology, 6 Roentgen St.
Secretaries, Drs. S. A. Reinberg and S. G. Simonson.
Meets annually.

Leningrad Roentgen Ray Society
Secretaries, Drs. S. G. Simonson and G. A. Gusterin.
Meets monthly, first Monday at 8 o'clock State Institute of Roentgenology and Radiology, Leningrad.

Moscow Roentgen Ray Society
Secretaries, Drs. L. L. Holst, A. W. Ssamygin and S. T. Konobejevsky.
Meets monthly on the first Monday at 8 o'clock, the place of meeting being selected by the Society.

Polish Society of Radiology
Secretary, Dr. Jan. Kochanowski, 45 Gornoslazka St., Warsaw. Meets annually.

Warsaw Section, Polish Society of Radiology
Secretary, Dr. B. Krynski, 11 Zielna St.
Meets once a month except in the summertime.

Scandinavian Roentgen Societies
The Scandinavian roentgen societies have formed a joint association called the Northern Association for Medical Radiology, meeting every second year in the different countries belonging to the Association. Each of the following societies, with exception of the Denmark Society, meets every second month except in the summertime.

Society of Medical Radiology in Sweden
Meets in Stockholm.

Society of Medical Radiology in Norway
Meets in Oslo.

Society of Medical Radiology in Denmark
Secretary, Dr. G. Biering, Copenhagen.
Meets on the second Wednesday of each month from October to July in Copenhagen, at 8 o'clock in the State Institute of Roentgenology.

Society of Medical Radiology in Finland
Meets in Helsingfors.

Vienna Roentgen Society
Meets first Wednesday of each month, at 6.30 P.M. at Zentral-Röntgen Institut des allgemeinen Krankenhauses Alserstrasse 4.

Orient

Japan X-Ray Association
c/o Orthopedic Surgery, Tokyo Imperial University.
Meets annually in April.

Kinki Roentgen-Abend Society
Director, Dr. Prof. Taiga Saito, Ogawaoike Tyoto, Japan. Meets bi-monthly on third Sunday.

LATIN-AMERICAN CONGRESS OF PHYSICAL THERAPY, X-RAY, RADIUM

The Latin-American Congress of Physical Therapy, X-ray, and Radium will hold its first annual meeting in Mexico City from August 29 to September 5, 1935. The National University of Mexico will act as host to their North American colleagues, and the government will participate in extending hospitality to the delegates.

To facilitate the attendance of American physicians at this Congress, a nineteen day convention cruise has been arranged, with steamer, rail, hotel, and sightseeing costs included in one all-expense fee. The convention cruise and all of its advantages will be available not only to the physicians, but to members of their families and their friends.

Five special tours to the Latin-American Congress and return have been arranged by the American Express Company which has been asked to direct the Congress Cruise. The first of these, which is expected to prove most popular, is a round-trip by steamer, the *S.S. Yucatan* having been especially chartered for the purpose of the Congress.

It will also be possible for physicians to make the round-trip by rail, or to go by steamer and return by rail.

Special arrangements have also been made for a return trip by rail, including a stop-over at Kansas City, for those who desire to attend the 14th Annual Scientific Session Congress of Physical Therapy on September 9, 10, 11 and 12.

In addition to first class hotel accommodations in Mexico City, delegates registered for the cruise will enjoy sightseeing trips to principal points of interest in Mexico City, a thirty mile drive to the pyramids of Buried City of San Juan Teatihuacan, all day water trips to Xochimilco and the floating Gardens, and to Cuernavaca, and to Toluca and the Desert of the Lions. On the outward bound trips the cruise will stop at Havana, and Progreso, and returning will call again at Havana.

The medical activities of the Congress will be held in the faculty rooms of the National University School of Medicine and will be divided into sections representing medicine and surgery, fractures in their various specialties, electrosurgery, fever therapy, short and ultra short wave therapy, light therapy, massage, radium, and roentgen therapy and exercise.

The officers of the Congress are Norman Edwin Titus, M.D., president; William Bierman, M.D., first vice-president; Heinrich Franz Wolf, M.D., second vice-president; Madge C. L. McGuiness, M.D., secretary, and Cassius Lopez de Victoria, M.D., executive director.

Delegates to the Congress desiring to present papers, will submit the titles of their papers, together with an abstract, to either Dr. Madge C. L. McGuiness, 1211 Madison Avenue, New York City, or Dr. Cassius Lopez de Victoria, 1013 Lexington Avenue, New York City.

FLORIDA STATE RADIOLOGICAL SOCIETY

The regular annual meeting of the Florida State Radiological Society was held at the Harrington Hall Hotel, Ocala, Florida, on May 12, 1935.

This meeting was held in conjunction with the meeting of the Florida State Medical Society. It convened at 10 A.M., and adjourned at 5 P.M. Luncheon for members of the Society was served in the hotel. The usual round table discussion of interesting and puzzling cases, which has been the method adopted by the Society since its inception, again proved unusually satisfactory. There were a number of visitors from the general session, who were pleased to make favorable comments on the character of the meeting.

The following officers were elected for the ensuing year: Dr. W. McL. Shaw,

Jacksonville, President; Dr. F. J. Payton, Miami Beach, Vice-President; Dr. Gerard Raap, Miami, Secretary-Treasurer.

The next annual meeting will be held in May, 1936, at Miami; the place of meeting for the semi-annual is yet to be determined.

MIDSUMMER RADIOLOGICAL CONFERENCE

The Radiological Club of Denver is sponsoring a Midsummer Radiological Conference to be held at Denver, Thursday and Friday, August 29 and 30, 1935. The program will consist of a symposium on chest diseases, one on gastrointestinal diseases, one on neoplastic diseases and one on development, anomalies, and diseases of the spine. A number of eminent radiologists are expected to participate in the program.

AMERICAN BOARD OF RADIOLOGY

The Board will not be in session at the meeting of the American Roentgen Ray Society at Atlantic City in September, but will convene at Detroit just preceding the meeting of the Radiological Society of North America in December. So many applications were already on file that the Board was unable to consider all of them in its session at the meeting of the American Medical Association at Atlantic City in June, and some of them had to be deferred until the Detroit meeting. New applicants who wish to appear before the Board at Detroit will be considered in the order in which the applications are received, but only until the quota is filled, and the new applications should be on file at least sixty days before the meeting.

B. R. Kirklin
Secretary

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers as space permits.

ECONOMIC PROBLEMS OF MEDICINE. By A. C. Christie, M.S., M.D. Professor of Clinical Radiology, Georgetown University Medical School; President, Fifth International Congress of Radiology; formerly President of the Medical Society of the District of Columbia, the American Roentgen Ray Society, the American College of Radiology, and Member of the Committee on the Costs of Medical Care. Cloth. Price, $2.00. Pp. 242. New York: The Macmillan Company, 1935.

In these times of social upheaval and economic stress, the statesman, the social worker, the philanthropist and the physician has each been confronted with the complex problem of providing medical care for humanity at large and each has tried to cope with the difficulties involved in his own way, often knowing too little of the activities and conflicting interests of others working toward the same end.

The author has condensed into a small readable book written with meticulous attention to detail a careful résumé of the world's literature on this subject. One hundred and fifteen articles and books, most of them written in recent years, are included in the bibliography and their teachings are described and analyzed by an experienced physician whose well-balanced scientific discussion of the facts should be welcome to the sober-minded, thinking individual regardless of his political, social or scientific affiliations. Although the problem touches him most intimately it becomes evident that too little has been written by the physician about the care of the indigent sick.

The first five chapters explain the necessity for a code of medical ethics and deal with the intricacies of modern medical education as well as the machinery known as organized medicine, pointing out the many benefits that have accrued to the people at large as a result of the system. If laymen could be induced to read this section many misconceptions produced largely by the literature and radio broadcasts of irregular practitioners would be cleared away.

The remainder of the book takes up the many plans for providing medical care which have been proposed or actually tried in various parts of the world. Such subjects as "taxation for medical care," "workmen's compensation laws," "health insurance," "industrial practise," "contract practise" and "corporate practise" are fully considered. The health insurance plans now in operation in Germany, France, England and Denmark are described and it must be admitted that much of the glamour imparted to them by our enthusiastic reformers disappears when the bare facts are viewed without bias. Those who feel that physicians are making no effort to solve the problem of medical care for the poor and indigent should read of the plans put in operation by organized medicine, principally in California, Michigan and the District of Columbia, in an effort to determine the most workable scheme. Data obtained from these experiments together with facts learned from the mistakes made abroad have been combined in the last two chapters to formulate a series of provisions which should be included in any comprehensive plan for medical care. The author emphasizes throughout the volume his conviction that "any solution which lowers the quality of medical care is worse than no solution."

Although physicians will find this book of much interest it is to be hoped that the mass of reliable information which it contains can in some way be placed in the hands of a large number of those thinking American citizens who mold public opinion.

CHARLES L. MARTIN

THE 1934 YEAR BOOK OF RADIOLOGY. Diagnosis, edited by Charles A. Waters, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Therapeutics, edited by Ira I. Kaplan, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, City of New York; Visiting Radiation Therapist, Bellevue Hospital, etc. Cloth. Price, $4.50. Pp. 512, with 454 illustrations. Chicago: The Year Book Publishers, Inc., 1934.

Medicine moves forward so rapidly that those content with knowledge gained in the medical school are quickly outdistanced. Textbooks are out of date soon after publication and only by the most arduous study of the current periodicals can the physician keep well informed. Radiologists, because of the relative newness of the field, have a special task in keeping abreast of the times. Periodicals are so numerous and published in so many languages that access to all of the important articles is not possible for everyone. Drs. Waters and Kaplan are yearly reviewing, abstracting and classifying the most important contributions and in the Year Book for 1934 they have well upheld the standards of previous volumes.

Four hundred and fifty-one articles are abstracted and classified, providing an invaluable source of material. New and unusual ideas are plentiful but the material is not limited to this type of article. Review and summaries of general papers are represented. Along with case reports on ochronatic alkaptonuria, osteodystrophia, fibrosa unilateralis, Lückenschädel and the like are discussions of roentgenology in rheumatism, a group of articles on malacic diseases and osseous changes in endocrine disturbance, diseases of the chest, gastrointestinal tract, etc. Aortography, arteriography, urography, filters in roentgenography and varied quality in simultaneous roentgenograms are among the technical considerations in the diagnostic section.

Therapy is equally well covered both as to new ideas and review of experiences. Space will not permit a résumé of the abstracts, all of which are interesting and important.

In general, articles are abstracted because of their genuine value as contributions to the advancement of science and the authors' comments are therefore usually favorable. But many are the words of caution against the too quick acceptance of new methods or deductions. The stamp of approval in the editorial comment should greatly aid the younger student in evaluating the knowledge gained.

The hospital graduate just entering on his specialty, as well as the older man who has allowed his library to suffer for financial reasons, should not delay in procuring this volume. It will be found useful for daily reference as well as invaluable as a guide to recent literature in preparation for scientific talks or papers.

Most radiologists having seen previous Year Books have availed themselves of the 1934 volume. The moderate price places the book within easy reach of all.

E. Walter Hall

X-Ray and Radium Injuries: Prevention and Treatment. By Hector A. Colwell, M.B., Ph.D., M.R.C.P., D.P.H., and Sidney Russ, C.B.E., D.Sc., F. Inst. P. The Barnato Joel Laboratories, Middlesex Hospital. Pp. 220. London: Oxford University Press, 1934.

Radiologists have long recognized the need of an authoritative and comprehensive work on the subject of radiation injuries.

This monograph by two acknowledged authorities is divided into fourteen chapters and appendix. The foreword is from the Chairman of the British X-Ray and Radium Protective Committee (Sir Humphrey Rolleston), and in it he states that his committee, though in no way entitled to any credit for the production of this valuable monograph, nor indeed privileged to be responsible, are proud to be allowed to welcome the appearance of such a monumental proof of the need for precautions which some perhaps may have regarded as in certain respects unnecessarily drastic. The general consideration of protection is discussed in the initial chapter. Successive chapters are devoted to injuries to the skin, respiratory tract, circulatory system, alimentary tract, nervous system, eye, ear, bone, cartilage, muscle, connective tissue, adrenals, thyroid, thymus, mammary gland, radiation sickness, changes produced by prolonged action of gamma radiation, poisoning by radioactive substances, x-ray and radium quackery. The appendix contains extracts from the third revised report (1927) of the recommendations of the British X-Ray and Radium Protection committee and a brief discussion of methods of dosage. The clinical, histological and therapeutic discussions are brief, but contain an admirable summary with many references and personal quotations from other workers. Each chapter is supplemented by a bibliography which, from its extent, indicates a tremendous amount of preparation through collateral reading. The text indicates scientific ability of the highest order, manifested by the results of personal investigation by the authors of the clinical and experimental effects of injuries of all kinds caused by roentgen rays, radium and radioactive substances.

This valuable work is one concerning which superlative adjectives may be honestly used.

It is really an outstanding and complete compilation of all obtainable knowledge on the subject, and is of value to the specialist and research worker, but deserves the close attention of all whose work involves roentgen rays and radium.

J. J. Moore

The Diffraction of Light, X-Rays, and Material Particles: An Introductory Treatment. By Charles F. Meyer, Associate Professor of Physics, University of Michigan. Cloth. Price, $5.00. Pp. 473, with 283 illustrations. Chicago: The University of Chicago Press, 1934.

This book presents a generally useful and lucid exposition of the subject. Its scope may be judged from the following chapter headings. 1. General and historical. 2. The method of zones. 3. The methods of lunes and the Cornu spiral. 4. Typical diffraction patterns of the Fresnel class. 5. The Fraunhofer class of diffraction phenomena. 6. The diffraction grating. 7. Sundry ramifications of diffraction theory. 8. The diffraction of x-rays. 9. The diffraction of material particles.

The treatment is systematic and relatively elementary in the sense that it is "not too mathematical" as the author puts it in his prefatory remarks; and the young physicist will find here a complete introduction to the subject of diffraction.

The chapter on the diffraction of roentgen rays should especially interest those readers of this Journal whose concern is with the fundamentals of roentgen-ray optics. The book as a whole is a valuable reference text for workers in optics.

Barnett Cohen

Books Received

Economic Problems of Medicine. By A. C. Christie, M.S., M.D., Professor of Clinical Radiology, Georgetown University Medical School; President, Fifth International Congress of Radiology; formerly President of the Medical Society of the District of Columbia, the American Roentgen Ray Society, the American College of Radiology, and Member of the Committee on the Costs of Medical Care. Cloth. Price, $2.00. Pp. 242. New York: The Macmillan Co., 1935.

The 1934 Year Book of Radiology. Diagnosis, edited by Charles A. Waters, M.D., Associate in Roentgenology, Johns Hopkins University; Assistant Visiting Roentgenologist, Johns Hopkins Hospital; Therapeutics, edited by Ira I. Kaplan, B.Sc., M.D., Director, Division of Cancer, Department of Hospitals, City of New York; Visiting Radiation Therapist, Bellevue Hospital, etc. Cloth. Price, $4.50. Pp. 512, with 454 illustrations. Chicago: The Year Book Publishers, Inc., 1934.

Apparatus and Technique for Roentgenography of the Chest. By Charles Weyl and S. Reid Warren, Jr., Moore School of Electrical Engineering, University of Pennsylvania. Cloth. Price, $5.00. Pp. 166, with 38 illustrations. Springfield, Ill.: Charles C Thomas, 1935.

Tumors of the Female Pelvic Organs (Macmillan Surgical Monographs. Elliott C. Cutler, Editor.) By Joe Vincent Meigs, M.D., F.A.C.S., Instructor in Surgery, Harvard Medical School; Surgeon to Out-Patients, Massachusetts General Hospital; Associate Surgeon, Collis P. Huntington Memorial Hospital; Surgeon, Pondville Hospital, Massachusetts State Cancer Hospital. With a Foreword by Robert B. Greenough, M.D. Cloth, Price, $6.00. Pp. 533, with 261 illustrations. New York: The Macmillan Co., 1935.

Practical Neurological Diagnosis: With Special Reference to the Problems of Neurosurgery. By R. Glen Spurling, M.D., Assistant Clinical Professor of Surgery, University of Louisville School of Medicine. Cloth. Price, $4.00. Pp. 233, with 99 illustrations. Springfield, Ill.: Charles C Thomas, 1935.

Röntgenbiologische Untersuchungen mit Gewebekulturen als Indikator. Von Børge Faber. (*Acta radiol.*, Suppl. xxi.) Paper. Price, Swed. cr. 8:—Pp. 119, with numerous tables and diagrams. København: Levin & Munksgaard, 1935.

Skin Cancer: A Clinical Study with Special Reference to Radium Treatment. By A. H. Wolfgang Magnusson. (*Acta radiol.*, Suppl. xxii.) Paper. Price, Swed. cr. 20:— Pp. 287, with 10 plates. Stockholm: P. A. Norstedt & Söner, 1935.

Mucous and Salivary-gland Tumours: A Clinical Study with Special Reference to Radiotherapy, Based on 254 Cases Treated at Radiumhemmet, Stockholm. By Hugo E. Ahlbom. (*Acta radiol.*, Suppl. xxiii.) Paper. Price, Swed. cr. 20:— Pp. 452, with 49 illustrations. Stockholm: P. A. Norstedt & Söner, 1935.

Das Ventrikulogramm. III. Teil. Dritter und vierter Ventrikel. Von Erik Lysholm, Dozent für Medizin, Radiologie; Bertil Ebenius, Knut Lindblom, Hans Sahlstedt, Assistenten am Röntgeninstitut. (*Acta radiol.*, Suppl. xxvi.) Paper. Price, Swed. cr. 12:— Pp. 124, with numerous illustra-

tions. Stockholm: P. A. Norstedt & Söners Forlag, 1935.

Röntgenologische Beobachtungen über die Ossifikation der Patella. Von Hans Hellmer. (*Acta radiol.*, Suppl. xxvii.) Paper. Price, Swed. cr. 10:— Pp. 82, with 211 illustrations. Stockholm: P. A. Norstedt & Söner, 1935.

Atlas der normalen Ossifikation der menschlichen Hand. (*Fortschr. a. d. Geb. d. Rötgenstrahlen*, Ergangzungsband 47.) Von Prof. Dr. F. Siegert, Ehemals Direktor der Universitäts-Kinderklinik Köln. Paper. Price, M.16.—; bound, M. 18.— Pp. 43, with 8 illustrations in the text and 36 plates. Leipzig: Georg Thieme, 1935.

Untersuchungen über die Möglichkeiten einer dreidimensionalen Röntgenographischen Abgrenzung innerer Organe des menschlichen Körpers. Von Carl Wegelius. Paper. Pp. 148, with 115 illustrations. Helsingfors: Mercators Tryckeri Aktiebolag, 1934.

La roentgentherapie des fibromyomes de l'uterus et des métropathies hemorrhagiques. By Paul Gibert. Préface du Docteur Antoine Béclère. Paper. Price, 18 fr. Pp. 111, with 10 illustrations. Paris: Masson et Cie, 1935.

Les ondes hertziennes courtes et leurs applications en médecine. Par le Docteur Etienne-Hubert Henrard, Electroradiologiste de l'Université de Paris; Radiologiste à Bruxelles. Paper. Pp. 116, with 10 illustrations. Bruxelles: Imprimerie Médicale et Scientifique, 1934.

A Summary of the Treatment of Fractures and Dislocations. By R. Broomhead, M.B. (Leeds), F.R.C.S., Surgeon, Orthopaedic Department, General Infirmary at Leeds, Consulting Orthopaedic Surgeon, St. James's Hospital, Leeds, Consulting Orthopaedic Surgeon, Dewsbury General Infirmary, etc. Paper. Price, 3/6d. Pp. 39. Leeds: Jowett & Sowry, Ltd., 1935.

Symposium on Silicosis: An unofficial transcript of the Silicosis Symposium held in connection with the Trudeau School of Tuberculosis at Saranac Lake, N. Y., June 18 to 22, 1934. Edited by B. E. Kuechle, Claims Manager, Employers Mutuals, Wausau, Wis. Paper. Price, $5.00. Pp. 99, 1934.

The Mortality from Tuberculosis: A Study of the Experience among the Industrial Policyholders of the Metropolitan Life Insurance Company 1911 to 1930. Monograph 1 and 2. New York: Metropolitan Life Insurance Company, 1935.

Annual Report of the Saskatchewan Cancer Commission for the Calendar Year 1933. Paper. Pp. 49. Regina: Thos. H. McConica, 1935.

One Hundred and Fifty Years of Publishing 1785–1935. Cloth. Pp. 42, with illustrations. Philadelphia: Lea & Febiger, 1935.

Cancer, Edinburgh 1934. Paper. Pp. 72. Published by the Cancer Control Organisation for Edinburgh and South-east Scotland. Edinburgh: E. & S. Livingstone, 1935.

A Review of the Work of the Radium and Deep Therapy Department, 1924–34, Christchurch Hospital, New Zealand. Paper. Pp. 35, 1934.

Report of the Fifth Australian Conference Held at Canberra, 17th–20th April, 1934. Paper. Pp. 79.

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ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

ROENTGEN DIAGNOSIS

HEAD

Beutel, A. Pathologische Veränderungen am Canalis opticus. (Pathologic changes in the optic canal.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 576–584.

Beutel discusses some of the anatomical variations and pathologic changes in the optic canal. He describes some of the dilatations caused by increased intracranial pressure from tumors, by the particular findings in a case of anophthalmus congenitus and some of the changes due to infiltration from tumors, and he illustrates some of the regenerative processes following radiotherapy of tumors.—*E. T. Leddy.*

Ebenius, Bertil. The results of examination of the petrous bone in auditory nerve tumors. *Acta radiol.*, 1934, *15*, 284–290.

Thirty-four cases of tumors of the auditory nerve, verified by operation, were examined by the author's roentgen technique. The internal auditory meatus was examined in a frontodorsal and an axial (submentovertical) projection. The meatuses on the two sides were photographed symmetrically, the two planes lying almost at right angles to each other.

All of the cases gave positive roentgen signs. About 80 per cent showed expansive destructive changes at the internal meatus. Among the remaining cases areas of destruction due to pressure were found in the apex of the petrous bone or in adjacent parts of the bone in 15 per cent; only 5 per cent showed no local changes.

This technique of frontodorsal and axial symmetrical projections proved superior to the methods that have been used heretofore. In Stenvers' oblique projection and other similar projections the internal meatus does not appear very distinctly. There is a typical funnel-shaped deformity of the internal auditory meatus in tumors of the auditory nerve which is of greater diagnostic value than mere expansion, as such expansion may cause no greater width of the meatus than is seen in many normal cases. The normal width of the meatus varies greatly.—*Audrey G. Morgan.*

Craig, Winchell McK. Malignancy of cerebral tumors. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 464–466.

The author discusses gliomas, which comprise about 40 per cent of intracranial tumors. The gliomas are classified in different groups according to the stage of the predominating cellular structure in its development from primitive medullary epithelium to the mature adult glial cells. The spongioblastoma multiforme and the medulloblastoma rank as the most malignant and would compare favorably with a carcinoma graded 4 elsewhere in the body. The average period of survival is 12 and 17 months respectively. These two groups compose 41 per cent of gliomas. Treatment can be only palliative by operation and irradiation.

The astroblastoma, the ependymoma, and the polar spongioblastoma correspond to tu-

mors elsewhere in the body of grade 2. They represent 2, 4 and 7 per cent respectively of the gliomas and the average period of survival is 28, 32 and 46 months respectively. The astrocytomas and the oligodendrogliomas are of low grade malignancy, the average period of survival being 66 and 76 months respectively. They constitute 27 and 18 per cent respectively of the gliomas. Tumors of these last five groups respond to one or more surgical procedures and irradiation.—*J. H. Vastine.*

NECK AND CHEST

Torelli, Gastone. Beitrag zur Kenntnis kleiner abgesackter supradiaphragmatischer Flüssigkeitsansammlungen beim Pneumothorax. (The recognition of small encapsulated supradiaphragmatic effusions occurring in pneumothorax.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 182–189.

The author describes the origin of pleuritis in pneumothorax which can be demonstrated only roentgenologically. It is observed in partial pneumothorax of the lower lobes. As the costodiaphragmatic sulcus is obliterated fluid collects between the lung and diaphragm. In the 15 cases observed by the author the lesion produced no symptoms and its discovery was purely by roentgen study. The lesion is best demonstrated by screen examination as by it the fluid is shown most easily.—*E. T. Leddy.*

Kopstein, G. Zur röntgenologischen Symptomatologie von Mittellappenerkrankungen. (The roentgenologic symptomatology of disease of the middle lobe of the lung.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 145–165.

The author discusses the usual methods of investigating perihilar densities and the hilar shadows, an analysis of which is of extreme clinical importance. Kopstein feels that the "cross-cavity position" (Kreuzhohlstellung) is the best one to demonstrate changes in the middle lobe of the lung, many of which are missed by other techniques. He demonstrates the validity of his opinion by showing prints of roentgenograms. He describes a wedge shadow occurring in the right lower lung field with its apex toward the axilla. By demonstrating this shadow lesions in the middle lobe not likely to be seen by other methods are demonstrated, it clarifies the nature of increased striations and will enable an analysis of hilar changes with greater accuracy. The author points out the frequency of pneumonic conditions in the middle lobe, recognition of which is difficult. He emphasizes the differential diagnosis of lobar and interlobar lesions, pointing out that in some cases an exact diagnosis cannot be made. —*E. T. Leddy.*

Teschendorf, H. J. Über besondere Erscheinungsformen der Grippepneumonie im Roentgenbild. (Some peculiar roentgen findings in influenza pneumonia.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 541–547.

This is a report of some roentgen studies made during the influenza epidemic of 1932–1933. Extensive confluent pneumonia was less common than small infiltrations, occurring most frequently in the lower lobes, but also in the upper lobes and which often could be demonstrated by roentgen examination alone. The clinical picture was often not characteristic and often it was difficult to make a differential diagnosis from tuberculosis. The roentgen characteristics are explained. Among them the most important was the inconstancy of the findings and especially the rapidity with which they changed on frequent re-examinations. The diagnosis was facilitated by the fact that the lung findings occurred in an influenza epidemic. —*E. T. Leddy.*

Lenk, Robert. Das charakteristische Röntgenbild der offenen Wabenlunge. (The characteristic roentgenogram of "open-mesh lung" (offenen Wabenlunge).) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 418–426.

Among the various congenital cystic lesions of the lung—the anatomy and pathogenesis of which are discussed—there is one to which the term "open-mesh lung" may be applied which is not very rare. Lenk reports 6 of these cases and on the basis of his own study of them and other cases described in the literature he has established a characteristic roentgenologic picture of the lesion. This may be summarized as follows: There is a large meshed network formed of thin striations of variable extent, absence of normal lung markings in this region; absence of all signs of past or present inflammation, such as abnormal streaked or flaked shadows; absence of fibrotic appearances; at times the presence of small typical shadows of fluid; no change in the roentgen findings over a period of months due to the non-progressive nature of the lesion. He discusses the differential diagnosis from other

pulmonary diseases such as tuberculosis, multilocular echinococcus cyst and bronchiectasis. Most of the cases have been regarded as tuberculosis and as such treated for a long time by the clinician. In order to avoid such a serious error Lenk feels that a knowledge of this lesion is necessary.—*E. T. Leddy.*

Weicker, Bruno. Multiples kleinknotiges Lymphogranulom der Lunge. (Multiple small lymphogranulomatous nodules in the lung.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 485–488.

A case of acute recurring pulmonitis running a fatal course in ten months with initial right spontaneous pneumothorax showed roentgenologically multiple small nodular flecks, at times confluent with a non-characteristic blood picture, and no lymphadenopathy, was shown to be one of lymphogranuloma at autopsy. The chest roentgenograms are reproduced.—*E. T. Leddy.*

Weltz, G. A., and Van Niekerk, J. Die Atmung des Asthmatikers im Kymogramm. (The respiration of the asthmatic as shown in the kymogram.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 534–541.

For the production of a true asthmatic attack an allergy is necessary which with a suitable exogenous stimulus leads to narrowing of the bronchi. The authors have reason to think that this narrowing is evoked by an urticaria like swelling of the bronchial mucous membrane and not by a spasm of the bronchial muscles. The stimulus which evokes the stenosis of the bronchi may originate in the intestine, the genital system or the nose. Once bronchial stenosis is present the type of breathing changes, the inspiratory musculature takes on an increased tension and as the result of this there is a spasm of the lungs. The hypothesis of a valve effect of the bronchi is groundless. The increased tension of the inspiratory musculature as a whole is the result of an inspiration reflex and occurs in man and in experimental animals with every stenotic dyspnea. Therefore, the theory of a special reflex neurosis in the asthmatic seems superfluous. The inspiration reflex occurring with stenosis is not identical to the Breuer-Hering reflex and does not pass through the vagus. In a severe attack the bronchial stenosis is accompanied by a deleterious effect on the circulation because during inspiration the aorta only partly fills and a venous back pressure takes place. In expiration the diastolic filling of the heart is made more difficult and there is no assistance offered by the tonic contracted diaphragm.—*E. T. Leddy.*

Saupe, E. Pleuritis mediastinalis superior oder Thymushyperplasie? (Superior mediastinal pleuritis or thymic hyperplasia?) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 314–320.

The aim of the present paper is to call attention to the important observations of Engel that widening of the upper mediastinal shadow to the right (rarely to the left) to end below in an angle that usually is less than a right angle and which may merge with the interlobar linear shadow on the right is caused by a superior mediastinal pleuritis. The author presents some observations of other changes which may hide or obscure the diagnosis. In differential diagnosis that of enlarged thymus occupies the foreground which lesion may present an identical picture. If the apex of the shadow lies at the level of the hilus or if its outlines form more than a right angle or if its lower end is less pointed or more curved, then thymic enlargement must be considered. Extension of the central shadow to both sides favors thymic enlargement. The observation of the bilateral lower shadow's transition into the heart shadow will allow differentiation from a bilateral upper mediastinal pleuritis, a point which the author has not yet had occasion to observe. A superior mediastinal pleuritis may be confused with other causes of widened mediastinal shadow, for example, stasis in the cava, by a shadow of an enlarged bronchus, etc. In many cases a lateral view is very helpful in making a diagnosis.—*E. T. Leddy.*

Hammarskjöld, B. A contribution to the knowledge of teratomas and dermoids in the anterior mediastinum. *Acta radiol.*, 1934, *15*, 210–224.

The author describes 2 cases of teratoma of the anterior mediastinum which were examined roentgenologically. The first case is particularly interesting. It was a case of metastatic chorionepithelioma of the lungs and brain that had originated from a teratoma of the anterior mediastinum in a young man of twenty-two. The second case was in a man twenty-eight years of age in whom roentgen examination suggested the possibility of a teratoid tumor in the anterior mediastinum. The diagnosis was

based chiefly on the experience in the first case. Operation confirmed the diagnosis and a large teratoma was removed.

In connection with these 2 cases the author discusses the origin and the roentgen diagnosis of teratomata. The author agrees with Budde's modification of the theory of Dangschat and Bonnet that teratomata are not to be considered genuine twin structures but that they originate from detached blastomeres from the primordial intestinal cavity. This explains the occurrence of chorionepitheliomatous tissue in the first case. The blastomere is multipotent before it becomes differentiated into the three germinal layers, and it may therefore give rise to any conceivable type of tissue. As to roentgen diagnosis, the author says that it is a mistake to classify dermoid cysts and solid teratoma together. The roentgen pictures are quite different, and only the dermoids are characterized by sharply circumscribed smooth rounded shadows.—*Audrey G. Morgan.*

Demant, Moritz. Die Frontalaufnahme in der Diagnose und Prognose der Thorazerkrankungen im frühen Kindesalter. (The frontal exposure in the diagnosis and prognosis of thoracic diseases in infancy.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 30–46.

Demant feels that the frontal exposure gives important diagnostic, prognostic, and at times even therapeutic, information. The author, in agreement with others, thinks that examinations made with a sagittal exposure are insufficient and he offers evidence to confirm his views. Frontal exposure should not be omitted and avoided merely because it is difficult technically and difficult to interpret. Combined roentgen procedures such as roentgenoscopic and roentgenographic examination are recommended, but frontal films may reveal evidence not obtainable otherwise.—*E. T. Leddy.*

Lysholm, Erik, Nylin, Gustav, and Quarnå, Kuno. The relation between the heart volume and stroke volume under physiological and pathological conditions. *Acta radiol.*, 1934, *15*, 237–257.

A study was made of heart volume and beat volume in a condition of rest in normal individuals, and in individuals with compensated and uncompensated heart diseases and hypertonia. The heart volume was determined in the morning immediately after the determination of the beat volume. Kahlstorf's method was used. The roentgenograms were made with the patients standing.

Under these conditions the beat volume and the heart volume are each approximately a positive linear function of the body surface in normal individuals. In normal individuals of different sizes under standard conditions the quotient heart volume : beat volume is relatively constant. Under standard conditions the beat volume falls below normal in cases of pronounced insufficiency of the heart, but the heart volume increases to beyond the normal limit. This results in a considerable increase in the quotient. In cases of compensated valve lesions and hypertonia the beat volume is normal, but in many cases the heart volume is increased pathologically. The quotient heart volume : beat volume seems to be a measure of functional condition of the heart during rest.—*Audrey G. Morgan.*

ABDOMEN

de Abreu, Manoel. Entzündliche Verengerung des Pylorus. (Inflammatory stenosis of the pylorus.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 558.

The author describes stenosing pyloritis which is a very common condition, occurring in 70 per cent of the cases of prepyloric and pyloric ulcer and in all cases of definite gastric inflammation. The roentgen signs vary with the stage of the disease—atrophic, stenotic, hypertrophic or mixed. In the first the pyloric canal is narrowed, stretched and rigid and the mucous membrane is more or less smooth. In the second the rugae are increased and they show marked niches. The emptying of the stomach is delayed; there is no actual spasm of the pyloric sphincter since it can be shown that these are organic inflammatory changes in the wall. These changes have been confirmed histopathologically. The author is of the opinion that inflammatory pyloric stenosis is the most common cause of gastric stasis and of hypersthenic dyspepsia.—*E. T. Leddy.*

de Abreu, Manoel. Absteigende Zwölffingerdarm-Entzündung. (Inflammation of the descending duodenum.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 547–558.

The author states that not infrequently changes in the wall of the duodenum from inflammation are incorrectly diagnosed spasm or perivisceritis. In the syndrome he describes the mucous membrane as thickened or in the later

stages thinned out from increase of fibrous tissue and atrophy of the muscle of the bowel. A narrowing of the lumen therefore results. The lesion may present the following forms, hypertrophic, fibrotic and stenotic. The descending duodenum is rigid, smooth and more or less dilated or narrowed, depending on the stage of the disease. Infection may spread to the gallbladder or to the stomach, so that in cases of inflammation of the descending duodenum there is often cholecystitis or cholelithiasis together with gastric and duodenal inflammation or ulceration.—*E. T. Leddy.*

Sandera, R. Über Lagevariationen der Flexura duodeno-jejunalis und des oberen Jejunum bei einem Typus des forminvers gelagerten Duodenum. (Variations in position of the flexura duodeno-jejunalis and of the upper jejunum in a type of inverted duodenum.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 22–29.

Another paper in the author's series on this subject describes a congenital inversion of the duodenum and Sandera discusses and describes the embryologic, the morphologic, physiologic, post-mortem, and roentgenologic findings in the case. Displacement of the duodenum and jejunum may be of sufficient clinical importance as to indicate its fixation surgically.—*E. T. Leddy.*

Blefari-Melazzi, Teofilo. I diverticoli dell' apparato digerente. (Diverticula of the digestive tract.) *Radiol. med.*, March, 1934, *21*, 263–289.

Cases of diverticula of the esophagus, stomach, duodenum, small intestine and colon are described and illustrated with roentgenograms. These diverticula of the digestive tract rarely cause symptoms unless they become inflamed, and even then the symptoms are not particularly characteristic, so that roentgen examination becomes of the greatest importance. Before the roentgen era they were generally discovered only on operation or autopsy. They may become inflamed just as the appendix does, but while the appendix is predisposed to acute inflammation, these diverticula generally present chronic or latent inflammation. Case, among 85 cases of diverticula of the duodenum, found duodenal ulcer with surprising frequency. He therefore believes that the presence of duodenal diverticulum tends to cause ulcer. Among 10 cases of diverticulum of the duodenum seen by the author, 3 showed ulcer of the duodenum, 2 cancer of the head of the pancreas, the sixth icterus from occlusion of the bile tract, and the seventh diverticulosis of the duodenum with marked gastric hyperchlorhydria. He has rarely seen diverticulum of the duodenum in individuals entirely free of disease of the digestive tract. Retention of the contents of the diverticulum causes putrefaction and secondary inflammation. The inflammation may remain limited to the mucosa of the diverticulum, but it may extend and cause peridiverticulitis and adhesions to neighboring organs. It may even cause abscess, gangrene, and fatal perforation peritonitis. In 70 per cent of the cases he has observed, the author has seen changes in the duodenum, liver or pancreas. He believes, therefore, that a systematic search for diverticula should be made in all roentgen examinations of the digestive tract.—*Audrey G. Morgan.*

Ivy, A. C. The physiology of the gallbladder. *Physiol. Rev.*, Jan., 1934, *14*, 1–102.

The author presents an excellent and complete review of important work in gallbladder physiology. It is so complete in its scope and so concise of form that much must be omitted in this abstract.

The gallbladder manifests the same reactions as the intestines. These may be classed and discussed under the following headings: absorption, secretion, and motor activity.

Absorption. The evidence at hand proves that the gallbladder does concentrate. Some studies on bile concentration indicate that gallbladder bile is 6 to 10 times more concentrated than the hepatic bile. These same studies seem to establish maximum concentration in the first twenty-four hours, very little increase being demonstrated in forty-eight hours. The gallbladder seems to be able to concentrate bile pigments more than it can plain bile. Cholesterol under normal conditions is not absorbed from the gallbladder. In disease, however, there may be deposited in the gallbladder contents cholesterol coming from its mucosal desquamation that attends gallbladder inflammation. Bacteria deposited within the lumen of the gallbladder have been found in the blood stream within one-half hour after injection.

The power to concentrate seems to be the result of the absorption of normal salt solution from the gallbladder at the rate of from 3 to 6.7 c.c. per hour. Stimulation of the vagus

nerve increased the rate of absorption while splanchnic stimulation decreased the rate of absorption. With increase in gallbladder concentration there is an increase in the acidity of its contents.

Some investigators have claimed that iodikon is absorbed from the gallbladder and that this absorption is enhanced by the ingestion of a fatty meal. The only reliable data indicate that the rate of tetraiodophenolphthalein absorption is so slow that it is impossible to explain the disappearance of the dye after the meal.

Studies on bile obtained at the operating table show that in acute inflammation, empyema, hydrops, and chronic gallbladder disease the gallbladder does not concentrate normally. Similar results attend experiments after damaging the gallbladder. In the papillomatous gallbladders, however, and those with hypertrophied rugae, the concentrating ability is increased. Evidence favors the concept that the gallbladder functions both in health and in disease. In disease, however, rather than having fluid poured out of the lumen, the fluid is excreted into the gallbladder. This explains the failure of gallbladder visualization in disease. Other factors in the absence of gallbladder shadow are: failure of the liver to excrete the dye adequately, incompetence of the sphincter of Oddi, and obstruction of the cystic duct.

Motor Activity. The gallbladder has been seen contracting at the operating table and under the roentgenoscope. There are two types of motor activity: (1) tonic contraction; (2) tonus rhythm. Tonic contraction produces a sustained rise in gallbladder pressure lasting from five to thirty minutes. Tonus rhythm is manifest by a rhythmical contraction and relaxation occurring at the rate of from 2 to 6 times per minute. The pressure exerted in the tonic contractions have been as high as 21 to 31 cm. of Ringer's solution. Introduction of egg yolk or N/10 normal HCl into the duodenum have produced a rise of from 21 to 26 cm. of bile. Under these same conditions there is evidence to believe that the bile ducts also contract.

Innervation of the Gallbladder. The muscle in the gallbladder is innervated by many nerve fibrils coming off of the ganglion cells which are situated in the gallbladder wall.

Pain, nausea, vomiting, and respiratory disturbances are under the influence of the vagus and splanchnic nerves. Pain is abolished by section of the right splanchnic nerve. Nausea and vomiting are influenced by section of the vagus verve. Respiratory changes are taken care of by section of either set of nerves.

Gallbladder contractions are enhanced by weak vagus stimulation. Such reflex stimulation of the central end of the vagus produces a contraction of the gallbladder, relaxation of the sphincter, contraction of the ampulla, and evacuation. This is what has been termed the "reciprocal innervation" of the gallbladder and sphincter of Oddi. During storage of bile the sphincter contracts and the gallbladder relaxes; during evacuation the gallbladder contracts and the sphincter relaxes. The law of "reciprocal innervation" is not adhered to in disease.

Evacuation of the Gallbladder in Man. The conclusions outlined above may be applied to man. In fact, many of the experiments have been performed in man. There is an unexplained difference in rate of evacuation of the gallbladder in males and in females. The gallbladders in children evacuate faster than in the young adult. It seems, however, that in males the rate of evacuation slows down after puberty while in the female this does not take place. Gallbladders have been found not to concentrate in pregnancy after the seventh month.

Fear, anxiety, pain cause some evacuation of the gallbladder which may in part be due to the action of the adrenals. Sometimes water may produce a slight contraction also. The most complete evacuation is obtained after a meal of five egg yolks and a glass of cream. Injection of this mixture into the ileum, colon, or rectum produced no effect. Gastrectomized animals responded after the meal, however.

There is still a great deal of uncertainty concerning the action of drugs upon the gallbladder. Pituitrin causes contraction. Pilocarpine and physostigmine have little or no effect. Choline probably causes slight emptying in man while epinephrine may possibly produce some delay in evacuation. Alcohol and atropine are also indefinite in their reactions.

In explaining the evacuation attending starvation, investigators have pointed to the evacuation associated with stimulation of the pylorus stating that the hunger contractions produce a similar effect. Stimulation of the duodenum near the ampulla of Vater causes relaxation of the gallbladder. The gallbladder, like the colon, may renew its contents each day.

There are many experiments pointing toward the hormonal gallbladder stimulation idea. The indications are that secretin is a cholecystokinetic hormone and as such has a direct influence upon gallbladder contraction. Unless this be accepted it would be most difficult to explain the gallbladder evacuation that occurs after blood transfusions in which the donor had previously partaken of a fatty meal.

Phases of Evacuatory Response. The period of initial response appears after a latent period of one minute and is complete in two minutes, probably being the result of psychic or reflex response due to food. Following this there is a minute pause during which the gallbladder relaxes or fills slightly due to return of sphincter to normal tone. Then comes the principal period of discharge during which from one-half to three-fourths of the contents are evacuated lasting from sixteen to sixty minutes. The period of quiescence then follows and lasts from five to forty-five minutes. The cycle may then be repeated several times. After eating, the bile flows into the duodenum for the first four hours, then flows into the gallbladder and duodenum, then flows into the gallbladder alone at the completion of digestion.

The monograph contains a most inclusive bibliography.—*P. J. Hodes.*

GYNECOLOGY AND OBSTETRICS

Moore, George E. Roentgen measurements in pregnancy. *Surg., Gynec. & Obst.*, Jan., 1933, *56*, 101–109.

To know the exact size and shape of the true pelvic inlet is generally admitted to be of extreme diagnostic value in any obstetrical procedure. In contrast to the waning methods of internal pelvimetry by manual and instrumental means, we now have the gradual advancement of the more popular procedure of roentgen pelvimetry and its associated method, cephalometry. The importance of this subject is realized when one considers that in this country alone over 20,000 women annually lose their lives from some complication of childbirth, and that more than three times as many infants die at the time of birth. Over half of the gynecological operations are performed with the idea of correcting some condition that had its inception at the time of childbirth. Since Budin and Varnier wrote on the subject of roentgen pelvimetry in 1897, numerous methods have been devised to determine the true pelvic diameters by correcting for the distortion due to the divergence of the rays. The author discusses several of these methods and describes a rather ingenuous device of his own. After a roentgenogram has been made of the pelvis and the patient removed from the table, a lead sheet is placed at the same level as the pelvic inlet. There are two perforations in the lead sheet 10 cm. apart which following a short roentgen exposure produce two black dots on the film which although they are actually 12 or more centimeters apart on the film represent 10 cm. at the level of the pelvic inlet. The author has an elastic scale bearing ten divisions; this scale is adjusted and fixed so that 0 and 10 are on the two dots on the film and each division on the scale then represents 1 cm. at the level of the pelvic inlet and any dimensions on the film can thus be measured with the corrected elastic scale.—*J. H. Vastine.*

Ehrhardt, Karl. Zur Biologie der intravenösen Plazentographie. (The biology of intravenous placentography.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 405–418.

This paper continues the discussion of three previous ones on placentography and takes up the biologic basis of the study in various animals. By a single intravenous injection of thorotrast the placenta can be visualized in gravid mice, rats, guinea pigs, rabbits and cats. These placentograms show characteristic differences in form and structure for each particular animal, so that the animal can be identified. Placentography is a largely reversible process but injections of large quantities of thorotrast lead to abortion. Small quantities have no deleterious effect on the pregnancy. Up to the present the method is not applicable to the human subject.—*E. T. Leddy.*

GENITOURINARY SYSTEM

Tescola, Carlo. Un caso di spiccata visibilità radiografica diretta della prostata ipertrofica. (A case of marked direct roentgen visibility of the hypertrophied prostate.) *Radiol. med.*, March, 1934, *21*, 260–262.

A patient came for examination of the bladder complaining of having passed bloody urine. He had no other symptoms except a slight feeling of weight in the perineum and a rather frequent desire to urinate. Five years before he had had renal colic and passed some small

calculi and some sand. Roentgen examination of the bladder region in the anteroposterior projection showed an oval opaque shadow in the midline just above the pubic arch. It was the size of a mandarin, its outlines were a little indistinct, it was homogeneously opaque and not so dense as the bone, so that the coccyx was distinctly visible through it. It proved to be the enlarged prostate. As a general rule, the prostate is not visible on the roentgenogram. Boidi-Trotti and Scaduto say that the hypertrophied prostate can be rendered directly visible by using a diaphragm with a diameter of 3 cm. with a very soft tube and the patient in a semi-sitting position. This roentgenogram was obtained by the usual technique, using rays of a 7 to 8 cm. spark gap and a Potter-Bucky diaphragm. Visibility can always be brought about indirectly by insufflation of gas into the bladder, the injection of contrast liquid, etc.—*Audrey G. Morgan.*

Ortmann, K. K., and Christiansen, Harold. Roentgenologic studies of the male urethra, the closing mechanism of the bladder, and the micturition under normal and pathologic conditions. *Acta radiol.*, 1934, *15*, 258–283.

The authors discuss the different theories of the mechanism of micturition and describe the musculature which performs this function. They particularly emphasize the great importance of free mobility of the region around the internal orifice and the prostatic part of the urethra, and the action of the vesicoprostatic sphincter.

They describe a method of obtaining a roentgenogram of the whole urethra, especially the prostatic portion, during micturition, by intravenous injection of uroselectan. They show its superiority to the method of direct injection of contrast fluid into the urethra or bladder. They give a series of roentgenograms showing the different types of normal and pathological micturition, illustrating the results they have obtained with this method.—*Audrey G. Morgan.*

Burgers, W. G. Diagnostizierung eines Uretersteines mit Hilfe einer Röntgeninterferenzaufnahme. (The differential diagnosis of the composition of the ureteral stone by means of roentgen-ray interference studies.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 228.

By the Debye-Scherrer interference method applied to a ureteral calculus and calcium oxalate the composition of the stone was shown to be calcium oxalate.—*E. T. Leddy.*

SKELETAL SYSTEM

Giraudi, Gioffredo. I punti d'ossificazione (cosidette "pseudoepifisi") della troclea delle falangi, del capitello dei primi e della base dei quattro ultimi metacarpali e metatarsali. (Centers of ossification—so-called "pseudo-epiphyses"—of the trochleae of the phalanges, the heads of the first and the base of the four last metacarpals and metatarsals.) *Radiol. med.*, March, 1934, *21*, 203–224.

In the metacarpals, metatarsals, and phalanges of the fingers and toes endochondral ossification usually takes place from one center in the diaphysis and a single supplementary center in the epiphysis. Ordinarily ossification extends along a solid front from the center in the diaphysis to the joint cartilage. Two other types may be seen, however. In the first, ossification from the diaphyseal center instead of developing along a solid front sends a projection into the cartilaginous epiphysis which is called a "pseudo-epiphysis," which grows toward the periphery, remaining constantly connected with the diaphysis by a bridge of bone. In the second type there is a supplementary center of ossification in the epiphysis symmetrical with the one which forms at the other end of the bone.

The author discusses the question of whether the deviations from the usual type are simply variations, whether they are atavistic or stigmata of a degenerative nature, or caused by abnormality of the endocrine glands, or whether they are due to changes which take place in prenatal development. In a few cases a transparent band can be seen completely separating the bone substance of the epiphysis from that of the diaphysis. The author found these deviations from the usual type in more than 30 cases of congenital malformation, in 3 cases of achondroplasia and 7 cases of generalized osteochondrodystrophies. They are particularly frequent in certain diseases of the endocrine glands, such as hypogenitalism and hypothyroidism. From his personal experience the author believes that in the majority of cases the centers are not pseudo-epiphyses but true epiphyseal centers of ossification.

A number of the author's cases are described and illustrated with roentgenograms, and a long bibliography of the subject is given.—*Audrey G. Morgan.*

van Dam, G. On active rotation of the metacarpalia, e.g. in "spreading" of the fingers. *Acta radiol.*, 1934, *15*, 304–308.

On maximum spreading of the fingers there is a rotation of the metacarpals in the direction of pronation that can be demonstrated roentgenologically. The movement may be one of pronation only, or rotation of the metacarpals only, or a combination of the two. Probably the intercarpal joint also plays a part in it. The slightly clenched hand also shows a marked rotation of the metacarpals. The second and perhaps the third metacarpal rotate in the direction of pronation, while the fourth and fifth turn in the direction of supination.

Active rotation of the metacarpals has not been discussed in the literature before. Roentgenograms and diagrammatic sketches are given.—*Audrey G. Morgan.*

Sachatschieff, A. Über Röntgendiagnose von Osteochondritis deformans coxae juvenilis. (The roentgen diagnosis of osteochondritis deformans coxae juvenilis.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 54–61.

In all cases of osteochondritis deformans coxae juvenilis the author has found defective development in the ischiopubic region. The bones are a few millimeters short and are rotated about the horizontal axis, so that the ischium is directed backwards. The obturator foramen is smaller than normal and appears narrow in the roentgenogram because the ischiopubic region is rotated. The diaphysis is normal. The symphysis is displaced toward the affected side. In tuberculous coxitis as well as in infectious or inflammatory diseases of the hip in children these changes are more definite at the ischiopubic region and the obturator foramen and the diaphysis of the femur is then atrophied and thinner than normal. In congenital dislocation of the hip the ischiopubic region is not shortened to any great extent but is rotated in the opposite direction so that the obturator foramen appears larger. The femoral diaphysis is thinner than normal. Differential diagnosis can be made by a varying combination of these signs. The author feels that osteochondritis is more likely an infection of the hip than a dislocation.—*E. T. Leddy.*

Chasin, Adib. Analyse des Röntgenbildes des Hüftgelenks. (Analysis of the roentgenogram of the hip joint.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 620–630.

Chasin shows that not all defects in the bones of the hip joint can be visualized roentgenologically. The minimal defect that can be seen in the head and neck of the femur depends on the age of the patient. The smallest defect that can be seen between the ages of ten to twelve years is 2–4 mm., between the ages of ten to seventeen years 3–8 mm., and at twenty years or more 5–9 mm. The absolute size of a defect that can be demonstrated roentgenologically in the tegmentum acetabuli has a varying importance depending on the age of the patient and the size of the defect. Defects which involve only one layer of the compacta are always demonstrable roentgenologically, regardless of the age of the patient. The thickness of the smallest defect, which is visible in the spongiosa, between the ages of ten and twelve years with intact compacta is 8 mm., between the ages of seventeen and twenty years 7–8 mm. This indirect relationship between the size of the defect and the age of the patient is explained by the fact that the spongiosa absorbs much more radiation in later life than it does in childhood. The difference in thickness of the compacta in the different age groups is, on the contrary, relatively not large. Therefore defects of the same size in the spongiosa of adults show up much more plainly in the film. The roentgenogram of the tegmentum up to the ages of ten to twelve years is produced mostly by the cortical layer. The foci in the spongiosa can only be visualized if they involve the compacta partly or entirely. To best demonstrate defects in the bones making up the hip joint it is advisable to use an oblique ventrodorsal projection in addition to the direct ventrodorsal one.—*E. T. Leddy.*

Svab, V. Bemerkungen zur Ostitis deformans Paget. (Some remarks on osteitis deformans Paget.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 475–484.

The author feels that in general the roentgen diagnosis of Paget's disease of the vertebrae is as accurate as it is in other parts of the skeleton. His observations agree with those of the school of Schmorl on the incidence of osteitis deformans in the spine and that the spine is more often involved than the lower leg, skull or other parts of the skeleton. Of 14 cases Svab observed, in 8 the disease could be demonstrated in the vertebrae; in 1 case the whole spine was involved. With osteitis deformans of the spine there is usually little pain except in

those cases where the disease is very extensive or where there is fracture or where the hypertrophic deformity of the spine has led to compression of the spinal cord. Roentgen examination is therefore usually necessary to demonstrate the presence of these vertebral lesions and to differentiate them from other pathologic conditions in the spine.

The increase of the sagittal and transverse diameters of the vertebral bodies and the thickening of the arches may be caused by periosteal deposits. Besides those forms of Paget's disease with a nonosseous, diosseous or polyosseous involvement there is also a generalized type of the disease. Numerous little transverse linear infractions of the long bones are a rare occurrence and heal without trace.—*E. T. Leddy.*

Lyon, Ernst. Spondylosis deformans, Arthrosis deformans der kleinen Wirbelgelenke und Nervensystem. (Spondylosis deformans, arthrosis deformans of the smaller vertebral joints and their relation to the nervous system.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 46–54.

There is a relation of neuralgic pain to the frequent spondyloarthritic process in the spine. In spondylitis deformans with medullary symptoms there is no reason to believe that the cause is osseous proliferation inside the spinal canal. The actual cause is a primary disease change in the spinal cord, or the meninges. Roentgen examination of the spine is therefore an important diagnostic procedure in cases with "neurologic" symptoms.—*E. T. Leddy.*

Lindén, Oskar. Case of ostitis fibrosa generalisata with well-marked tendency to spontaneous cure. *Acta radiol.*, 1934, *15*, 202–209.

A case is described in a man who on his first examination in 1929 was twenty years old. In the course of a little less than a year his condition grew rapidly worse, he became bedridden and suffered from exhaustion and severe pain. Roentgen examination showed extensive destruction of bone which was attributed at that time to tumor metastases. Gradually, however, spontaneous improvement began and in six months he could walk on crutches, and after six more months he was able to walk without support. Shortly after that he was able to go back to work and is now clinically well. Repeated roentgen examinations have shown progressive healing of the bone lesions. The blood calcium values are still high, however, which shows that he is not definitely cured.

Spontaneous recovery is rare in this disease. The patients generally die. The prognosis is not so hopeless, however, as it formerly was, since it has been found that it may be cured by removal of adenomata of the parathyroid glands. These adenomata, however, are probably only a part of the disease. Probably several endocrine glands are affected. Patients with osteitis fibrosa frequently show symptoms of Basedow's disease, and women are apt to have mental disturbances. In some cases of adenoma of the parathyroids there are no symptoms of osteitis fibrosa. These adenomata do not cause osteitis fibrosa unless they are toxic, just as a goiter does not cause Basedow's disease unless it is toxic.—*Audrey G. Morgan.*

BLOOD AND LYMPH SYSTEM

Capua, Antonio. Iniezioni di Thorotrast colloidale nella cavità peritoneale per lo studio della diffusione del mezzo di contrasto per le vie linfatiche. (Injections of colloidal thorotrast into the peritoneal cavity for a study of the diffusion of contrast medium through the lymphatics.) *Radiol. med.*, March, 1934, *21*, 289–294.

The author injected thorotrast into the peritoneal cavity of laboratory animals in order to study the diffusion of the contrast medium in the abdominal cavity. The contrast medium diffused rapidly throughout the abdominal cavity without showing special organs. There were some opaque lines probably representing injected lymphatic vessels. The peritoneum was irregularly opaque, particularly the greater omentum. Histological examination showed that the endothelium was almost entirely intact, but beneath it there was a thick layer of epithelioid cells infiltrated with thorotrast. There were no signs of inflammatory reaction, except a few foci of small cell infiltration in the greater omentum. Traces of thorotrast were found in the stellate cells of the liver, but the liver was not injected to nearly such a degree as after intravenous injection. The contrast medium passed upward to the thorax. In the first experiment three opaque glands appeared at the upper opening of the thorax, but the connections between them and the peritoneal lymphatics could not be seen. In the second experiment these glands could be seen, and also the lymphatic tracts leading to them. In this experiment there was also injection of the lymphatics of the pleura, of the intercostal

spaces, and slight injection of the peritracheal lymphatics.—*Audrey G. Morgan.*

TENEFF, STEFANO, and STOPPANI, FRANCO. Osservazioni sulla linfografia. (Roentgen demonstration of the lymphatics.) *Radiol. med.*, March, 1934, *21*, 235–260.

As long as a century ago efforts were made to demonstrate the lymphatics by injecting mercury into the chief lymphatic trunks of the cadaver and making an anatomical search for it in the smaller trunks. Now, with the aid of roentgenography, it is possible to study the lymphatic system in living animals as well, with what may be called mathematical accuracy. The authors studied the different substances used for this purpose and found that colloidal suspensions of thorium are the only media suitable for roentgen study of the lymphatics in the living animal. Thorotrast gives very marked contrast, passes only through the lymphatics, and does not injure the tissues. Experiments were also made with cinnabar but while this substance gives excellent contrast it injured the tissues and could not therefore be used clinically. Thorotrast was used in experiments on guinea pigs, rabbits and dogs. The substance was injected either into the lymphatic tracts or directly into the glands. Beautiful roentgenograms were obtained of the lymphatics of the limbs of these animals, from which the normal and pathological anatomy of the organs could be studied.

The results on the human subject, living or dead, were not nearly so good. No substance has yet been found that has a special affinity for the lymphatics of human beings. In comparing the roentgenograms obtained from living and dead animals the authors found the diffusion of the substance was not nearly so good in the living animals, probably because of a vital defensive action on the part of the lymphatic system. This, however, does not explain the difference in animals and human subjects which is due to unknown causes.

In animals whose popliteal and inguinal lymphatic glands were removed, the lymphatic circulation was quickly re-established, either by other vessels taking over the functions of those that were removed, or by the formation of new lymphatic vessels.

The authors think there are many interesting possibilities in this method. It should be possible by means of it to demonstrate inflammatory and neoplastic lesions in the lymphatic tracts, and study the new routes taken by lymph in carcinoma metastases and thus probably foresee the probable localization of later metastases. It might be possible by using substances which produce secondary radiation to exercise a therapeutic action on tumors and also to block the lymphatic circulation, preventing dissemination of the malignant disease. —*Audrey G. Morgan.*

ROENTGEN AND RADIUM THERAPY

HOEDE, KARL. Vorführungen zur Frage der Röntgenschädigungen bei Hauttuberkulose. (Roentgen injuries in skin tuberculosis.) *Strahlentherapie*, 1933, *48*, 680–684.

Reports of roentgen injuries in skin tuberculosis have two defects: either the amount of irradiation is not given or they are reports from physicians or institutions that have seen only the cases in which injury was done. False conclusions may be drawn from such reports. Severe roentgen injuries have only been produced when too large doses of radiation have been used. A number of such cases are illustrated and the dosage is given.

From the experience of the Würzburg Clinic the author concludes that roentgen treatment of skin tuberculosis with the proper technique does not cause injury. Injuries are caused by improper technique or lack of experience. It has been claimed that the skin of children is particularly sensitive to irradiation, but the author has had particularly good results in children. Statistics do not show an increase of lupus cancer with increased roentgen treatment, and often cases of lupus cancer cannot be shown to be due to roentgen irradiation. To avoid injury large doses of irradiation should not be used over areas that have been irradiated before, over very extensive foci, on the neck or in places where the skin is stretched tightly over underlying bones, cartilages, or tendons, especially over joints and on the ear. "Roentgen cancer" can be successfully treated by diathermia.—*Audrey G. Morgan.*

SCHULTE, G. Siebenjährige Erfahrung mit der Grenzstrahlenbehandlung des Lupus. (Seven years' experience with ultra soft ray treatment of lupus.) *Strahlentherapie*, 1933, *48*, 690–697.

Seven years ago when the author began to use ultra soft treatment for lupus he used one-third of an erythema dose. While this often causes undesirable reactions in other skin dis-

eases, he found that in lupus the more intense the reaction the better the results. He then adopted higher doses and had better and more uniform results. When reports began to come out in the literature of late injuries he thought it advisable to reduce the doses and the results were not so good. But from an examination of the published cases of injury he concluded that either too high tensions had been used or that the irradiation had been given over places that had previously been irradiated with roentgen or radium rays. Careful examination of his own cases, particularly capillary examination, showed that there had been no injury and he returned to the higher doses. He uses a first dose that causes quite an intense skin reaction in the form of a dark red erythema; occasionally even on the first irradiation there are small vesicles and erosions. A dose of 2,000 to 2,500 r with 10 kv. and 10 ma. and a focus skin distance of 5 cm. almost always causes this reaction. The interval before the second irradiation depends on the reaction after the first. If the reaction is moderately strong the second treatment is given after one week, and the third after two weeks, both with the same dosage as the first.

The different forms of lupus react differently. He has had the best results in the verrucous and in the ulcerous forms. Smaller doses can be used in these than in the other forms. Recurrences can be cured by another irradiation. The skin does not become refractory as it frequently does after roentgen irradiation. The chief advantage of ultra soft ray treatment over other methods is that it is cheaper and the time required for treatment is shortened. The majority of the patients in recent years have been treated with ultra soft rays alone and have been treated as out-patients. Many of them have not even stopped their work. The author has not seen any late injuries of any importance. One child with a very hypertrophic lupus of the extensor side of the elbow joint was given 42,000 r in the course of ten months. The skin is normal at present except for slight pigmentation. The lupus focus is cured. It is not advisable to give intense ultra soft ray treatment over areas that have previously been treated with roentgen or radium rays.

Photographs of treated cases are given.—*Audrey G. Morgan.*

Zieler, Karl. Die Röntgenbehandlung der lupösen Hauttuberkulose. (Roentgen treatment of lupus skin tuberculosis.) *Strahlentherapie*, 1933, *48*, 670–679.

It is true that injuries were caused by roentgen irradiation of lupus in the early years of the roentgen era when little was known about the action of the rays, but when the proper technique is used lupus can be cured by roentgen irradiation. Roentgen irradiation alone, however, is not the treatment of choice in lupus. As a general rule it should be combined with corrosive treatment, with pyrogallol, pyotropin, or similar drugs, or surgical incision of the focus with the diathermia loop. General dietetic treatment should also be given with the Sauerbruch-Herrmannsdorfer or Gerson diet and general arc light treatment or ultraviolet light. When roentgen rays are used alone 80 to 100 per cent of a full dose is used, equal to 16 to 20 S with a filter of 3 mm. aluminum, corresponding to about 4 mm. aluminum half-value layer. This amount of radiation is given twice or exceptionally three times, with an interval of six to eight weeks between treatments. When roentgen irradiation is given in association with other forms of treatment, only about 60 to 80 per cent of the full dose is given. It should not be repeated in less than six months. Not more than three full doses is ever given over a single focus as a total dose. The roentgen treatment is given after or toward the end of a local treatment. It is no longer used as it formerly was as a preliminary treatment before local Finsen light treatment.

The by-effects of roentgen irradiation are very slight if these rules are followed. They may be very severe if too large doses are used, or if the treatment is prolonged for a long time in divided doses. Treatment with the proper technique, however, gives smooth, soft scars, which are perhaps not so satisfactory as those after Finsen light treatment, but Finsen light treatment requires a much longer time and is much more expensive. The chief objection to the use of roentgen rays has been that they may cause lupus cancer. This is not true if the proper technique is used. Cancer sometimes develops in lupus with other methods of treatment. The author has seen cancer in 28 cases of lupus, in 19 of which roentgen irradiation had not been used.—*Audrey G. Morgan.*

Hummel, Rudolf. Zur Röntgenbehandlung der Trigeminusneuralgie. (The roentgen treatment of trifacial neuralgia.) *Strahlentherapie*, 1933, *47*, 684–688.

The roentgen treatment of trifacial neuralgia was introduced by Wilms in 1918. He had particularly good results in the symptomatic forms, which occur in diseases of the teeth, eyes, ears, nose and accessory sinuses and of the brain and meninges.

The author has treated 36 patients with trifacial neuralgia with roentgen rays in the Roentgen Institute of the Surgical University Clinic of Leipzig from 1922 to 1932. Twenty-three of the patients were men and 13 women. Their ages were from nineteen to seventy-seven years, the average age being 52½ years. A table is given showing the details of the results. Nine of the patients died of intercurrent disease, leaving a total of 27. In 5 of these patients, or 18.6 per cent, cure was brought about, and in 5 other cases such great improvement that the patients only occasionally have trifacial pain on change of weather. Temporary relief from pain lasting from four to twelve months was brought about in 11 cases, or 40.6 per cent. There was less pain after the recurrence than there had been originally. There was complete failure in 6 cases, or 22.2 per cent. Among the 7 cases that had been unsuccessfully treated with alcohol injections, 2 died of intercurrent disease, 1 was cured, 1 showed marked improvement, 2 temporary improvement, and 1 no results.

The author irradiates the Gasserian ganglion from the temple or cheek over a field 6 by 8 cm. in size with 30 cm. focus skin distance, 0.5 mm. zinc, and 3 mm. aluminum filter, 106 kv., and 4 ma. with a dosage of 200 to 250 r. Three treatments are generally given at intervals of eight days. Except for temporary loss of hair there was no very great skin reaction. Even in patients irradiated several years ago there are no telangiectases in the irradiated areas.

The author's figures of 37.2 per cent cure or great improvement show that roentgen therapy should be tried before surgery in trifacial neuralgia.—*Audrey G. Morgan.*

Hoffmann, Wolfgang. Strahlentherapie bei den tuberkulösen Erkrankungen des Auges. (Radiotherapy in tuberculous diseases of the eye.) *Strahlentherapie*, 1933, *48*, 790.

Radiotherapy was not used in diseases of the eye until about ten years ago because of the great sensitiveness of the tissues of the eye. Doses which only cause temporary irritation of the skin cause serious injury of the eye. Cataract and glaucoma may occur as a result of irradiation and the lens is the most sensitive part of the eye.

Roentgen and radium therapy are valuable in tuberculosis of the lacrimal sac as function can be restored, which is impossible with surgery. Ultraviolet irradiation gives better results than roentgen therapy in tuberculosis of the conjunctiva. Ultraviolet irradiation is also of value in the treatment of superficial diseases of the eyeball itself but radium or roentgen irradiation is required for deeper-seated diseases. Roentgen treatment of the eyeball is most effective in the productive forms of tuberculosis in which the iris is chiefly or exclusively involved; it is also valuable in episcleritis and keratitis. If the ciliary body is involved the results are not so good. In the exudative forms which are hypersensitive to tuberculin harm is apt to be done. The results are uncertain in the late secondary forms with extensive adhesions and many small nodules on the papillary border of the iris, with opacities of the vitreous body, keratitis and scleritis.

In favorable cases the action of the roentgen rays begins in twelve to twenty-four hours; there is a temporary increase of irritation followed soon by rapid improvement. Different authors report from 50 to 80 per cent improvement, the differences depending on the selection of the material more than on differences of technique. Stock gives 20 per cent of a skin erythema dose with 0.5 zinc and 3 mm. aluminum filter and if repetition is necessary does not give it before eight weeks. Others prefer a softer radiation with only 3 mm. aluminum filter and 10–30 per cent of an erythema dose given several times at intervals of one to two weeks. Roentgen irradiation is a dangerous treatment for tuberculosis of the posterior part of the eyeball.

For the past five years the author has used only gamma rays in the treatment of tuberculosis of the eye. He has treated 159 cases which have been under observation for a year or longer. The treatment failed in only 7, or 4.4 per cent. There were 15 cases of detachment of the retina, associated in 7 with tuberculosis of other parts of the eye. The inflammatory symptoms were cured in all but the detachment of the retina was corrected in only 2.

The irradiations were given with 30 mg. radium placed in 15 cells and filtered with 0.2 platinum. These cells were placed in a rectangular carrier with a brass wall 1 mm. thick which covered a surface of 13×18 mm. In dis-

eases of the anterior part of the eye an irradiation of 72 mg-hr. was given in three days at a distance of 1 cm. In diseases of the posterior part of the eye 288 mg-hr. was given in four to six days at a distance of 2 cm. Sensitive cases were given half this dosage. If necessary the irradiations were repeated after a week. No injuries were caused by this treatment. The effect of radium begins more slowly and acts more gradually than that of roentgen rays. The action was so mild that the author was often tempted to give larger doses to hasten the action. But the late results were found to be so good that this was unnecessary. Some exudative cases are so sensitive that even small doses of radium radiation cannot be borne but the range of cases that can be treated is much greater than for roentgen rays.

The skill of the physician is tested in selecting the kind of radiation and the technique of application that is best adapted to the individual case.—*Audrey G. Morgan.*

Kohlmann, G. Die Röntgentherapie des Hydrocephalus internus und verwandter Krankheitsbilder. (The roentgen treatment of internal hydrocephalus and similar conditions.) *Strahlentherapie*, 1933, *47*, 689–693.

This treatment is not entirely new but it is not yet very much used. This may be due partly to the difficulty of definite diagnosis, but partly also to the fact that many neurologists and clinicians do not know what can be accomplished by roentgen treatment in increased intracranial pressure.

The roentgenogram shows the digital impressions deepened at least in old cases. In obscure cases encephalolography should be performed as an aid in diagnosis, as in internal hydrocephalus there is great dilatation of the lateral ventricle so that the brain often forms only a thin mantle around the brain cavities. Another diagnostic point is increased lumbar pressure. Lumbar puncture is important, both in diagnosis and treatment.

The author irradiates through the skull. Some authors advise making a window in the skull and irradiating the brain directly, but many patients refuse this and he believes that the same results can be attained by lumbar puncture. The rays inhibit secretion of spinal fluid. Marburg and Spiegel have shown by experiments on dogs that large doses of radiation reduce it to a minimum. In one of the author's cases in which he made a diagnosis of tumor of the brain he used much larger doses than are generally necessary in hydrocephalus, and the production of spinal fluid was reduced to a very low level.

He gives the so-called effective dose over five fields, four lateral and one on the top of the head. In severe cases he gives 50 to 60 per cent of a skin erythema dose per field, and in mild or moderately severe ones 35 to 40 per cent, one field being irradiated every day or every other day. Recently he has been giving 60 to 70 per cent over the frontal field. The patient should be warned that there may be a temporary loss of hair. Two or three series of treatments should be given, but it is often hard to induce the patients to return for the later series as they feel well after the first one.

Four cases are described with cure or great improvement in three. One patient did not return for the third series of treatment and died suddenly after having been so well that his parents considered him cured.—*Audrey G. Morgan.*

Fuhs, Herbert. Zur Therapie der schwarzen Haarzunge (Lingua nigra pilosa). (Treatment of black hairy tongue (lingua nigra pilosa).) *Strahlentherapie*, 1933, *47*, 694–697.

Lingua nigra pilosa is an inflammatory hypertrophy and cornification of the filiform papillae brought about by different causes. It is harmless and does not cause any special symptoms except perhaps in some cases a pasty taste, but many patients like to have it treated for cosmetic reasons, and because they fear it indicates a malignant disease. Recently roentgen rays have been used in the treatment of this condition. The tongue is extended and the tip held by the patient, the rest of the mouth and face being protected by lead rubber. A dosage of 100 r is given at a distance of 20 cm., 120 kv., 0.5 mm. aluminum filter. Generally cure is brought about by two irradiations at intervals of two weeks. In some cases radium treatment is also used, a flat contact irradiation being given with 0.2 mm. silver filter and a dose of 4 to 6 mg-hr. Three cases are described in which this treatment was used successfully.—*Audrey G. Morgan.*

Attilj, Sordello. La röntgenterapia delle laringiti tubercolari e delle tonsilliti croniche. (Roentgen therapy of tuberculous laryngitis and chronic tonsillitis.) *Radiol. med.*, March, 1934, *21*, 224–234.

The author used roentgen treatment in 13 cases of laryngitis and 5 cases of chronic tonsillitis accompanied by changes in other organs, particularly the kidneys. He irradiated from four fields, two lateral, one anterior and one posterior, directly on the larynx and pharynx, on four successive days, with a filter of 0.4 mm. zinc and 1 mm. aluminum, focal distance 23 cm., 2 ma., 12 minutes' time, spark gap 31 cm., 120 kv. Each field was given a surface dose of 280 r, or a total of 1,120 r. Dosage for the pharynx and larynx was about 500 r. Generally he gave only one series of irradiations. If necessary, the series can be repeated after six to eight weeks. The 13 cases are described.

The author believes that all cases of tuberculous laryngitis, with a few very rare exceptions, can be treated by this technique. There were no bad after-effects, and remarkable cures and improvements were brought about. The few unfavorable results were in cases in which there was severe disease of the lungs. In chronic tonsillitis the results of this technique which affects the whole of Waldeyer's ring were very good, both on the local and the general condition. He recommends wider use of this method, which necessitates close collaboration between the roentgenologist and the laryngologist.—*Audrey G. Morgan.*

Zange, J. Strahlenbehandlung der Kelkopftuberkulose. (Radiotherapy of tuberculosis of the larynx.) *Strahlentherapie*, 1933, *48*, 705–727.

Various forms of radiotherapy of tuberculosis of the larynx are discussed, including general sunshine treatment, direct irradiation of the inside of the larynx with reflected sunlight, ultraviolet treatment, general arc light treatment, and roentgen treatment. Roentgen treatment is the preferred method where hospital treatment is impossible and there are no special arrangements for other methods of irradiation. It has only a local action on the focus, and no effect on the general tuberculosis. It is a stimulant action and produces its effect indirectly by the destruction of lymphocytes and leucocytes, the products of disintegration of which act on the focus and stimulate the uninjured connective tissues to scar formation. An effort must be made to determine the dosage which will affect the lymphocytes and leucocytes without injuring the connective tissue. If treatment for the pulmonary or general tuberculosis is not given at the same time the laryngeal tuberculosis may be healed, but the patient may die of the lung disease.

A distinction must be made between the exudative and proliferative forms of tuberculosis of the larynx. In the former only small palliative doses can be given for the control of pain. Not more than 5 or at most 10 per cent of a skin erythema dose can be given for the focus calculated at a depth of 3 cm. Pain and difficulty in swallowing are overcome with these doses. In the productive forms, however, very good results can be obtained. A table is given showing the results in 180 cases, in 46 per cent of which cure or almost complete cure was brought about, with improvement in 23 per cent more. In only about half of the 350 cases seen, however, was real therapeutic treatment possible; the others could only be given palliative treatment with small doses. In the productive forms 30 to 50 per cent or even 60 per cent of a skin erythema dose was given on two fields. The tuberculosis of the larynx may be productive but the patient may have an exudative tuberculosis of the lung at the same time. In such cases extreme care in dosage is necessary. The doses are given at intervals of four, six or eight weeks, depending on the reaction. If renewed irradiation is not given until the former reaction has passed off, there is no danger of severe injury of the larynx, such as has been described in the literature. Larger doses at long intervals are better than small divided doses, not only because injury is avoided but because the organism makes better use of the irradiation and the patient's general treatment can be continued.

Illustrations of treated cases are given.—*Audrey G. Morgan.*

Bacmeister, A. Die Strahlenbehandlung der Lungentuberkulose. (Radiotherapy of pulmonary tuberculosis.) *Strahlentherapie*, 1933, *48*, 747–752.

Radiotherapy of pulmonary tuberculosis is a stimulant therapy the biological manifestation of which is the focal reaction. Exudative caseous forms of tuberculosis grow worse on stimulant therapy if it is intense enough so that very great focal reactions are brought about. And the progressive forms of productive tuberculosis are not very well adapted for radiotherapy, as the granulation tissue is generally injured so that it cannot respond to the stimulus of the irradiation with healing, but renewed exudation and rapid disintegration are brought

about. The stationary productive forms of pulmonary tuberculosis and those with a tendency to latency respond very well to radiotherapy.

Any form of stimulant therapy must be very carefully adapted to the individual case. No routine scheme of treatment is possible. If there are other stimulant factors present they must be taken into consideration in determining the dosage. A roentgen treatment that is suitable at a low level would be overdosage at a height of 1,500 to 1,800 m. An irradiation that would be well borne on a cloudy day may produce undesirable focal reactions in bright sunlight. The first bright days of early spring often lead to the formation of exudative foci. All these factors, as well as the constitution of the patient, must be carefully considered when giving roentgen treatment. It requires great medical skill to decide which cases of pulmonary tuberculosis to irradiate, and to determine the dosage. The object of radiotherapy is to bring about contraction and cicatrization. If there are extensive adhesions which prevent contraction any form of stimulant therapy is not only useless but harmful. Surgical treatment may, in such cases, establish the necessary conditions for irradiation.

While radiotherapy of pulmonary tuberculosis is valuable if given with care and skill, it is a dangerous weapon if not so used. Its great advantage over sunshine treatment lies in the fact that small foci can be irradiated. The great difficulty in this as in other forms of stimulant treatment lies in the fact that in chronic pulmonary tuberculosis there are generally both productive and exudative foci, and the greatest care is necessary in order to avoid injury. In order to be sure that there are no fresh exudative foci the patient should be kept under observation for three or four weeks. If he is free of fever on rectal measurement for that time, quartz lamp irradiations may be given to test his sensitiveness to light, and then roentgen treatments may be begun. The blood picture should be kept under constant observation. By observing changes in the white blood picture, the sedimentation value, and the temperature, together with all the other clinical symptoms, it should be possible to avoid overdosage and bring about the desired result.—*Audrey G. Morgan.*

Baensch, W. Zur Röntgentherapie der tuberkulösen Lymphome. (The roentgen treatment of tuberculous lymphomata.) *Strahlentherapie*, 1933, *48*, 766–770.

In the roentgen treatment of tuberculous lymphomata leucocytes are apparently destroyed, setting free substances which injure the bacteria. The first stage of simple tuberculous lymphogranuloma with soft elastic enlargement of the glands is best adapted for roentgen treatment. Most of these cases can be cured with four or five irradiations of 15 to 20 per cent of an erythema dose. In the later stages of fibrous lymphogranuloma, suppurative caseous lymphoma with cold abscesses or fistulas and the last stage of suppurative caseous lymphofibrogranulomatosis with hard immovable nodules the conditions are not nearly so favorable.

Holzknecht says that the more severe the tuberculosis the lower the dose, and the author believes that this is true for tuberculosis of the mesenteric glands. In these cases he gives 20 to 30 per cent of an erythema dose and repeats it at intervals of two to three weeks. For the glands of the neck 30 to 50 per cent of an erythema dose may be given three times at intervals of a week. Opinions differ as to the best filtration. He prefers a heavy filtration of 0.5 mm. zinc and 3 mm. aluminum. The longer irradiation with heavy filtration gives better results and there is less danger of skin injury from cumulation. The course of the disease is so long that there is considerable danger of cumulation from small doses. There is no necessity for the edema of the larynx and dryness of the mucous membranes reported in the literature if care is used in dosage.

Cure can be brought about in 90 to 100 per cent of the cases in the first stage with a treatment of three to five months. Pediatricians should therefore be urged earnestly to use irradiation in this stage, and not wait for the stage of suppuration. The author's material shows 71 per cent cure, though 34 per cent of the material had reached the stage of suppuration or fistula formation.

Sunshine treatment is the treatment of choice for surgical tuberculosis, but the majority of patients cannot be treated for months in heliotherapy institutes for financial reasons. In large cities, therefore, a combination of roentgen therapy with quartz lamp treatment is the best substitute. Simple soft lymphomata should never be removed operatively. In the stage of cold abscess with threatened suppuration the

abscess should be incised. If there are old fistulas leading to caseous foci cure can generally be brought about by curettage with a sharp curette. Radical removal of the glands is to be considered only in the fifth stage in which hard masses of connective tissue prevent the absorption of caseous material.—*Audrey G. Morgan.*

Guthmann, Heinrich. Die Strahlenbehandlung der weiblichen Genitaltuberkulose. (Radiotherapy of female genital tuberculosis.) *Strahlentherapie*, 1933, *48*, 776–789.

Tables are given showing the comparative results of operation and irradiation in female genital tuberculosis. Each method has its advantages and disadvantages. The figures show that the results of combined operation and irradiation are somewhat better than those of either method alone, but operation should not be used in cases in which there is danger of a high operative mortality. Operation is indicated primarily in the exudative forms of genital and peritoneal tuberculosis in which exploratory laparotomy is necessary for diagnosis, and often also serves as sufficient treatment. Diseased parts that are not adherent can be removed at the same time. Extirpation of the uterus is only exceptionally indicated, as tuberculosis of this organ can generally be cured by irradiation. If there are large amounts of ascites the author believes they should be removed by puncture, as absorption takes place very slowly. After irradiation the amount of fluid formed decreases. Caseous masses and abscesses in Douglas' pouch which frequently result from mixed infection should be emptied if possible through the vagina. If there is danger of ileus operation should be performed. This practically exhausts the indications for operation. In the productive form in which there are extensive adhesions still greater caution should be exercised in operation as there is danger of causing fistulas. Operation in such cases should be limited to exploratory laparotomy or exploratory incision. It goes without saying that if the patient is in very poor general condition, or the process is very extensive, care should be exercised even in exploratory laparotomy. All patients who are operated upon under the above conditions, and all who are not operated on, should be irradiated. The whole of the diseased territory should be irradiated and it is safest to use large fields, extending from the umbilicus to the symphysis, and from the anterior-superior spine of the ilium on one side to that on the other. There is no uniform tuberculosis dosage.

Operative and roentgen treatment should be combined with physical and dietetic measures. The ideal treatment of genital tuberculosis is a combination of operation, roentgen irradiation and ultraviolet light treatment.—*Audrey G. Morgan.*

Wagner, E. Über die Morbidität und Mortalität der Radiumbestrahlung des Uteruskarzinoms. (The morbidity and mortality of radium irradiation in carcinoma of the uterus.) *Strahlentherapie*, 1933, *47*, 651–657.

Almost every carcinoma of the uterus is already infected before the patient comes for treatment. This is a serious factor both in operation and irradiation. The defensive power of the blood against the bacteria can be measured to a certain extent by the Ruge-Philipp virulence test. The general reactive capacity of the body to infection which is a question of constitution is very hard to judge. It is shown partly by a rise of temperature after radium irradiation. In spite of the greatest care it is not always possible to prevent severe infection in radium treatment of carcinoma of the uterus, which occasionally causes death.

The author reports morbidity and mortality in 127 cases of carcinoma of the uterus in which 322 radium treatments were given. Among these 114 were carcinomata of the cervix, and 13 carcinomata of the body of the uterus. Slight fever occurred after the irradiation in 62 of the cases. In 16 cases there was high fever which persisted for a considerable time; 5 of these cases are described in detail. There were no deaths.—*Audrey G. Morgan.*

Fried, C. Indikationen und Grenzen der Entzündungsbestrahlung in der Gynäkologie. (Indications and limits of irradiation for inflammation in gynecology.) *Strahlentherapie*, 1933, *47*, 672–683.

The author considers only the so-called pyogenic inflammations, which may be either acute, subacute or chronic. He also considers only the method of irradiation with small doses of from 60 to 120 r primary irradiation. Permanent sterilization for the treatment of inflammation has fortunately been abandoned and even temporary sterilization is not much used at present. In treatment with small doses there is no danger of injuring future children. Roentgen irradiation brings about hyperemia

much better than any superfiical application of heat. Even large exudates are absorbed very quickly. Maximum results are obtained a few hours after a single application. Several applications may be used, however, providing the total dose is kept low enough so that it does not bring about sterilization. The percentage of good results reported from different clinics is approximately the same, varying from 75 to 85 per cent. Guthmann reported 26 per cent cures in cases of non-gonorrheal adnexitis and 18 per cent in cases of gonorrheal adnexitis that had resisted other forms of treatment. These percentages represent what can be accomplished by roentgen therapy over and above what can be obtained by other methods. In addition to this the time required for treatment is shortened. Among the author's irradiated cases, only 42 per cent had to be treated more than four weeks, while among the non-irradiated cases more than 80 per cent had to be treated longer than that time. Among the patients who could be irradiated on the first or second day after admission to the hospital, the average time of treatment was 18.9 days. Pain and fever were very quickly controlled. Irradiation with small doses is well borne even in patients in poor general condition with great emaciation and high fever. Even irregular hemorrhages from disease of the adnexa are not a contraindication to the treatment, nor do they interfere with its effectiveness. On the contrary, the treatment tends to regularize the periods and overcome dysmenorrhea. The author advises against using the treatment in the early months of pregnancy. Even small doses might cause abortion or be held responsible for an abortion or premature delivery from other causes, as well as for any anomalies with which the child might be born.

The exact limits of indication for the treatment have not yet been established. The author formerly did not use it in gonorrheal diseases of the adnexa, but now finds that it is effective in these cases. The best results are obtained if treatment is given in the early stages of the inflammation. It is indicated in the treatment of perimetritis and endometritis. It has proved valuable in the treatment of pelvic peritonitis originating from the genitalia and in residual abscesses in the pelvis after operation. The author has also used it successfully in puerperal sepsis, a case of which is described.—*Audrey G. Morgan.*

Holfelder, H. Röntgentherapie der Knochen- und Gelenktuberkulose. (Roentgen therapy of bone and joint tuberculosis.) *Strahlentherapie*, 1933, *48*, 771–775.

The best treatment for bone and joint tuberculosis is sunshine, but roentgen irradiation is of great value in controlling pain in tuberculosis of the joints. With proper dosage pain is stopped generally in twenty-fours, and not later than forty-eight hours. This makes it possible to mobilize the joints, and in many cases to prevent ankylosis. Roentgen irradiation also shortens the time required for treatment. A combination of roentgen irradiation and general treatment decreases the number of cases in which surgical operation is necessary.

Only small doses of heavily filtered radiation should be used in the treatment of bone and joint tuberculosis. One field should be irradiated at a time and a sufficient interval left before the next irradiation to enable the body to utilize the previous irradiation completely. The more acute the course of the disease, the smaller the individual dose and the longer the intervals between the irradiations. While there is no uniform tuberculosis dose, the author, as a rule, gives 130 to 150 r, measured in air, on each field. A fungus tuberculosis requires a smaller dose than a fistulous and a secreting tuberculosis. Larger doses are required for very painful joints. Sometimes in cases of abscess or fistula doses of 300 to 450 r may be indicated, but they should not be used if there is danger of such foci rupturing into adjacent cavities. Caution should be exercised in using roentgen therapy for growing children.—*Audrey G. Morgan.*

Horsch, K. Zur Strahlenwirkung auf Krebsmetastasen der Wirbelsäule. (The effect of irradiation on cancer metastases in the spinal column.) *Strahlentherapie*, 1933, *47*, 698–707.

According to Schmorl's statistics, metastases occur in the spinal column in about two-thirds of all cases of cancer of the breast. Generally several vertebrae are affected and in the majority of cases the metastases are in the bodies of the vertebrae. The cervical spinal column is less frequently affected than the other segments. The author describes a case in a woman forty years of age in which metastasis began in the cervical vertebra, particularly in the arches and the spinous processes. Roentgen irradiation was given, two fields being given a

dose of 100 per cent of a skin erythema dose each, with 170 kv., 5 ma., 30 cm. focus skin distance, and 0.5 mm. zinc filter. This brought about a deposition of calcium in the parts of the vertebrae that had been destroyed and the return of the normal outlines of the bone. Healing did not occur. After a few months the calcium disappeared again but was brought back to a certain extent by another irradiation, but in the meantime a diffuse osteolytic-osteoplastic carcinosis of the whole spinal column and other bones had developed from which the patient died.—*Audrey G. Morgan.*

Langendorff, H., and Langendorff, M. Über die biologische Wirkung von sehr grossen Röntgendosen. (The biological action of very large doses of roentgen radiation.) *Strahlentherapie*, 1933, *47*, 723–726.

In a recent work, Schechtmann and Klupfel have reported experiments in which they studied the effect of roentgen rays on frogs' eggs. They used doses from 400 up to 72,000 r but in spite of this enormous increase of dosage the eggs preserved their capacity for division for twenty-fours hours. There did not seem to be any difference in the degree of injury caused by doses of 400 r and 72,000 r. Schechtman and Klupfel concluded from these results that the capacity of cells for segmentation cannot be directly destroyed by roentgen rays, and that there is an upper limit to the effective biological dose.

In former experiments the authors of this article noted that axolotl larvae 1 to 2 cm. long died during the irradiation when large doses were given. They therefore repeated the experiments of Schechtmann and Klupfel as they believed there must be some error in the results of those authors. They used axolotl eggs which have about the same degree of roentgen sensitiveness as frogs' eggs. They found that when large doses were given in a short time the eggs could be killed at once. The dose that caused immediate death of axolotl eggs was about 600,000 r, while a dose of even 200 r is sufficient to cause death of the eggs in twelve days. This shows that there is no upper limit to the biological effectiveness of the roentgen rays. It may be that the time factor influenced the results of Schechtmann and Klupfel as they gave their dose of 72,000 r in three hours, while the authors' dose of 600,000 r was administered in ten minutes.—*Audrey G. Morgan.*

Schreus, H. Th., and Willms, E. Weiterer Beitrag zur Pathogenese des Röntgenkaters. (The pathogenesis of roentgen sickness.) *Strahlentherapie*, 1933, *47*, 715–722.

Willms found that after irradiation, particularly of the trunk, and before the beginning of roentgen sickness, there is an increase of beta-oxybutyric acid in the blood and to a less extent of acetic acid. If these acetone bodies were produced immediately by the irradiation without any intervening substance it was hardly to be expected that the acetone body increase could be transmitted from animal to animal by injection of blood or urine, but if some substance were set free in the irradiated area that produced acetone bodies elsewhere transmission seemed possible. Tbe authors injected the blood of patients with roentgen sickness subcutaneously into rats. The rats were killed after two hours and the blood examined for acetone bodies. It was found that this produced an increase of acetone bodies in the blood of the rats. The increase was chiefly in beta-oxybutyric acid. The amounts showed that the acetone bodies were not simply injected into the rat's blood with the human blood.

Attempts were then made to determine the nature of the substance that brings about the increase of acetone bodies. It is apparently similar to, if not identical with, the fat metabolism hormone discovered by Anselmino and Hoffmann.

As roentgen sickness is preceded by increased acetone bodies in the blood, it seemed reasonable to suppose that it could be cured or prevented by agents which overcome acetonemia, and as a matter of fact they had excellent results in preventing roentgen sickness or curing it after the first signs appeared with doses of 5 to 10 units of insulin.—*Audrey G. Morgan.*

Hug, Waldemar. Der Röntgenkater und seine Bekämpfung mit Cardiazol-Ephedrin. (Treatment of roentgen sickness with cardiazol-ephedrin.) *Strahlentherapie*, 1933, *47*, 708–714.

Roentgen sickness is characterized by exhaustion, headache, nausea, and frequently vomiting and diarrhea. It has been attributed to disturbances of metabolism, particularly a change in blood cholesterin. Recently, however, the theory is generally accepted that it is a result of the action of roentgen rays on the nervous system, particularly the vegetative

nervous system, and that the changes in the blood and metabolism are secondary. There is increased vagus tonus and decreased sympathetic tonus. Based on this theory, the author tried the use of cardiazol-ephedrin which increases sympathetic tonus. The effect of ephedrin begins more slowly than that of cardiazol but lasts longer. Therefore, the therapeutic action of the combination begins sooner than that of ephedrin alone and lasts longer than that of cardiazol alone. The combination with cardiazol reduces the required dose of ephedrin and causes it to be better borne. The author used it in cases in which the patient had had roentgen sickness once. He used the drug in the liquid form or in tablet form. Injection was never necessary. As a rule, 20 drops of the liquid was given before the beginning of irradiation, a tablet in the evening, and if necessary another tablet the next morning. In almost all cases this was sufficient to prevent a reappearance of the sickness. A tablet is equivalent to 1 c.c. of the fluid preparation and contains 0.1 gm. cardiazol and 0.015 ephedrin hydrochloride. He has used the remedy in more than 50 cases, in only 2 of which it had no effect. In 1 very cachectic patient it had only a slight effect. In all the other cases the results were excellent. —*Audrey G. Morgan.*

Dietel, F. G. Leberextrakt gegen Röntgenkater. (Liver extract in roentgen sickness.) *Strahlentherapie*, 1933, *48*, 110–113.

The author gave injections of 2 to 4 c.c. of liver extract (hepatrat) to 15 women with severe symptoms of roentgen sickness and they were completely cured within an hour. The injections were given intramuscularly. If there was not considerable improvement within half an hour after the first injection of 2 c.c. the same dose was given the second time. All of the patients reported, however, that there was a certain amount of improvement soon after the first injection. In the future the author proposes to give injections of liver extract after every roentgen irradiation and during radium irradiations. In this way it should be possible to prevent not only acute roentgen sickness but the gradual roentgen cachexia which develops particularly on the use of protracted fractional irradiation. The effect of the preparation seems to be to raise the decreased serum cholesterin content. The active principle seems to be the same one that is effective in the treatment of pernicious anemia.—*Audrey G. Morgan.*

Guidotti, Carlo, and Perotti, Desiderio. Contributo alla roentgenterapia protratta ad alte dosi frazionate die tumori maligni. (Protracted fractional roentgen therapy with large doses in malignant tumors.) *Arch. di radiol.*, 1934, *10*, 78–90.

The author used Coutard's method of treatment in 29 cases during 1933. They included carcinomata of the pharynx, mouth, breast, uterus and vagina, rectum, sigmoid, lip, skin, lung, metastatic carcinoma of bone, lymphosarcoma of the small intestine, osteosarcoma of the mandible and tumor of the brain. Sixteen of the cases were inoperable, either surgically or by the ordinary methods of roentgen therapy

The authors' technique was as follows: one daily application of 60 r; filter 1.5 mm. copper and 2 mm. aluminum, focus-skin distance 50 cm., 170 kv., 3 ma., 50 treatments. In this way a dosage of 3,000 r was given in 50 treatments, with a dosage of 3 r per minute. The size of the fields varied from 50 to 600 sq. cm. This cycle of radiations was never repeated on the same field.

While the results were far from brilliant, the author believes that this method extends the limits of operability of tumors, that is, that cases can be treated by this method in which any other method of treatment is impossible. More than half of these patients could not have been treated by the old methods. But with the fractional method there was always temporary disappearance or reduction of the tumor and improvement in the local and general condition. With further perfection of the technique still better results can doubtless be obtained.—*Audrey G. Morgan.*

Schumacher, Paul. Klinische Erfahrungen mit protrahiertfraktionierter Intensiv-Röntgenbestrahlung bei inoperablen und rezidivierenden malignen Genitaltumoren und Mammakarzinomen. (Clinical experience with protracted fractional intensive roentgen irradiation in inoperable and recurrent malignant genital tumors and carcinomata of the breast.) *Strahlentherapie*, 1933, *47*, 338–343.

Such good results have been reported from protracted fractional intensive roentgen irradiation in inoperable tumors of the tongue, tonsils and hypopharynx that the author decided to try the method in inoperable and recurrent tumors of the genital organs and breast. He now reports his results in 45 such cases.

He used 210 kv., 2 mm. copper filter, 2.1 mm. Cu half-value layer, 2.5 ma., focus-skin distance 50 to 80 cm., and large fields 10×15 cm. and 20×20 cm. in size. The apparatus gave a dosage of 5.5 r per minute with a focus skin distance of 50 cm. Only one field was irradiated per day, with a surface dose of 200 r. If the general condition grew worse or the blood picture was greatly impaired, treatment was discontinued for from one to several days.The total number of irradiations was from 10 to 40, and the focal dose from 2,000 to 3,000 r. The treatment, as a rule, lasted from four to six weeks, but if it had to be interrupted it sometimes required ten weeks.

In the beginning of the treatment the irradiations were very well borne. The smaller the fields and the individual dose, the less serious the effect on the patient's general condition. Patients in relatively good condition bore the irradiation much better than cachectic patients, but sometimes even in patients in good condition such severe toxic symptoms were caused by rapid breaking down of large tumor masses that the treatment had to be interrupted. Often toward the end of the treatment the general condition was so seriously affected that the irradiation had to be stopped for long intervals. Patients practically always lost weight but as a rule they regained it after treatment was stopped.

A complete blood examination was made twice a week. There was generally a decrease of leucocytes, particularly lymphocytes. Often in the second half of the treatment when large abdominal fields were irradiated for ovarian carcinomata the leucocytes fell to 3,000 or less, and the lymphocytes fell from 24 to 30 per cent to 6 or 10 per cent. When the leucocytes dropped below that figure the patients became very weak. The author therefore adopted the method of stopping irradiation when the leucocyte count reached 3,000, and treating the patients until the count rose to 4,000. There were no very serious skin reactions. The most in tense reactions were in the sacral fields, which often became red and swollen. In one case after the application of 1,200 r to a sacral field there was swelling followed by generalized eczema of the whole body, from which the patient recovered after two weeks' treatment. There was strikingly little injury of the bladder and rectum, though these organs necessarily fell within the field of irradiation.

Among 8 inoperable carcinomata of the cervix of groups III and IV, systematically treated with 2,500 to 3,000 r, 3 receded very rapidly until only small residues were left, 3 others showed no change and 2 grew worse during the treatment. Two recurrences in the lateral wall of the pelvis and parametrium after radical abdominal operation disappeared quickly on irradiation with 2,100 and 2,300 r. In 3 other cases of extensive recurrence in the pelvis the treatment was ineffective. Several cases of inoperable carcinoma of the uterus that had been treated with radium and a single intensive application of roentgen rays did not react to the protracted fractional treatment. Very good results were obtained in 12 cases of inoperable carcinomata of the ovary, in some of which general carcinosis of the peritoneum and omentum had developed with ascites. The whole abdomen was irradiated with 2,300 to 2,700 r over a period of seven to ten weeks. Puncture had to be performed frequently to relieve the ascites. The method was also used in 10 cases of recurrence after amputation of the breast, but these cases are too recent for definite judgment to be passed on them. The method was not effective in the treatment of sarcomata. In both sarcomata and carcinomata the method sometimes shows good results for the first three months, but later the tumor grows worse or metastases develop.

The author thinks this serves as a warning that the general and local defensive forces of the body should not be injured by too intense irradiation. He thinks the doses recently recommended by some authors are too high. In the future more attention should be paid to the general condition and the blood picture of the patient, and the fields should not be any larger than is necessary for homogeneous irradiation of the diseased tissue. The amounts of irradiation to be applied in an hour should not be as great as those recommended by Coutard.—*Audrey G. Morgan.*

COLA, G. La fisiotrapia dell'asma bronchiale. (The physiotherapy of bronchial asthma.) *Arch. di radiol.*, 1933, 9, 709–733.

Physiotherapy is a very valuable method of treatment in bronchial asthma. It is not adapted for all cases but should be reserved for serious forms of the disease that resist other treatment.

The best methods of treatment in the adult are those of Schilling-Klewitz, of Mueller-Gerber, of Ascoli and Epifanio and the mixed

treatment of Schilling and Ascoli. The method of Schilling-Klewitz is roentgen irradiation of the thorax with a spark gap of 32 cm., 2 ma., focus distance of 30 cm., filter 0.5 mm. copper and 1 mm. aluminum, 2 anterior and 2 posterior fields 10×12 cm., dose per field 240 r, treating one field a day for eight days. The treatment may be repeated after an interval of two months. The method of Mueller and Gerber is roentgen irradiation of the thorax and spleen. They irradiate 7 fields 10×15 cm. on the thorax, two fields 8×10 cm. for the hila and one field 6×8 cm. for the spleen. The dose for each field is ½ an erythema dose. The method of Ascoli-Epifanio is irradiation of the hypophysis with a spark gap of 34 cm., 1 to 2 ma., focus distance 30 cm., filter 0.5 mm. copper and 1 mm. aluminum, two fields temporal and frontal, one field irradiated every other day with a dose of 200 r per field. For children ultraviolet irradiation is to be preferred. Gassul uses diathermia of the spleen but the author does not find this method so reliable.

Of course, rigid schemes of treatment must not be used but they must be adapted to the individual case. In cases in which there is dysfunction of an endocrine gland or some irritative factor, such as enlarged tracheobronchial glands, the treatment should be directed primarily to suppressing the source of irritation. If no such definite factor can be demonstrated, however, it is best to irradiate the thorax first and then the hypophysis.

The mechanism of action of the rays is probably complex; they overcome the congestion of bronchial mucous membrane, destroy the acidophil cells of the hypophysis which tend to produce asthma, restore the equilibrium of the vagosympathetic system, desensitize the organism and reëstablish the equilibrium of the biocolloids. The mechanism of action of ultraviolet irradiation is similar and Gassul thinks that diathermia furthers the production of antibodies that desensitize the organism.—*Audrey G. Morgan.*

Krause, Paul. Kritischer Bericht über die Grundlagen und Erfahrungen mit der Röntgentherapie bei Karzinomen des Magen- und Darmkanals. (Roentgen treatment of carcinoma of the stomach and intestines.) *Strahlentherapie*, 1933, *47*, 125–136.

The author reports the roentgen treatment of 35 carcinomata of the stomach, which he selected from among 169 cases as being adapted for radiotherapy. Also 28 carcinomata of the esophagus, 15 of carcinoma of the rectum, 9 of the bile tract with severe chronic icterus, and 2 each of carcinoma of the liver and pancreas. The carcinomata of the bile tract, liver and pancreas were hopelessly inoperable.

Forssell, in his classification of tumors with reference to roentgen treatment, groups carcinomata of the stomach and intestine in the fourth class in which he says radiotherapy is only a palliative method. The author is inclined to agree with this decision. He has never seen real permanent cure in such carcinomata, but he describes cases not only of carcinoma of the stomach, but also one of primary sarcoma of the stomach, in which roentgen treatment brought about disappearance of the tumor and complete freedom from metastasis for as long as six years. Roentgen treatment is very much worth while in these cases if only for the relief from pain. Both the physical and psychic condition of the patients is greatly improved and life is prolonged, sometimes for years.

The same is true of carcinoma of the esophagus. None of his patients were definitely and permanently cured, but in 21 of them the tumor was destroyed to such an extent that the stenosis of the esophagus was overcome and it was possible for the patients to take nourishment, thereby improving both their subjective and objective condition very greatly.

Carcinomata of the rectum should always be operated upon if they are operable. Unfortunately, they are very frequently not diagnosed until they are inoperable. The necessity for careful digital palpation and rectoscopy in these cases is emphasized. In these cases roentgen treatment is of great value associated with dietetic treatment, regulation of stools, chemotherapeutic treatment for the control of spasm, hemorrhage, and pain. In the author's cases the patients' general physical and psychic condition was greatly improved. Pain and spasm were controlled for months.

Roentgen treatment was given in the case of chronic icterus with the object of making the common duct permeable, which was accomplished successfully in all of the cases. In one case of tumor of the pancreas, the tumor was considerably decreased in size, and the glycosuria was overcome.

Various techniques are used in roentgen therapy of carcinomata of the stomach and intestines, showing that none of them are completely satisfactory. The author has found

Holfelder's method valuable. Sufficient filtration is absolutely necessary. He uses the usual thicknesses of copper, aluminum and silver. He has not found that silver has the special advantages that are claimed for it by some authors. He has had excellent palliative results with small doses. He has seen pain controlled by 20 per cent of an erythema dose given twice within three days. He has given doses as high as 100 to 150 per cent of an erythema dose, or even 300 per cent. With this dosage great care is necessary in order to avoid injury. He has tried Coutard's method but has not found that it gives particularly superior results.—*Audrey G. Morgan.*

Mazer, Charles, and Katz, Benjamin R. Diagnosis and treatment of functional uterine bleeding. *South. M. J.*, Jan., 1934, *27*, 13–20.

The probable mechanism of normal menstruation is discussed and endocrinopathic bleeding is explained as being due to a break in this normal cycle. There may be prolonged, though not necessarily excessive, production of estrin, and the absence of the controlling influence of progestin. A marked deficiency in estrin production will result in an amenorrhea, while a prolonged or excessive production induces endometrial overgrowth and necrosis eventually resulting in an abnormal uterine hemorrhage.

In the diagnosis of functional uterine hemorrhage, all non-endocrine causes must be eliminated and, if possible, the internal secretory gland primarily responsible should be determined. A history of a late onset of the menarche, irregularities of the menstrual cycle, primary dysmenorrhea, sterility and repeated abortions without apparent causes point to an endocrinopathy. The Goldzieher test for the specific dynamic action of protein is of inestimable value in the diagnosis of pituitary deficiencies. Pituitary deficiency, however, is no factor in the bleedings of menopausal women. Here there are sclerotic changes in the ovary which prevent completion of the follicular cycle even in the presence of an excessive stimulation from the anterior pituitary. Manifestly, pituitary therapy is irrational in these cases. Derangements of the thyroid, either of the plus or minus type, may be responsible for abnormal bleeding and are easily recognized. Finally, the importance of differentiation of abnormal uterine bleeding from an early threatened abortion is stressed. The hormonal tests are most valuable in this connection.

Abnormal uterine bleeding at or near the menopause should be treated by radium following an exploratory curettage for diagnosis. The use of radium in the childbearing period should be restricted to those cases where all other measures have been unsuccessfully employed in order to avoid sex function disturbance and severe menopausal symptoms that often follow its use. Temporary relief is occasionally obtained by curettage in younger women, more frequently in the older woman. The adminstration of progestin as a temporary measure is clinically effective. In cases where the presence of local or systemic conditions of non-endocrine origin can be eliminated, the use of antuitrin-s or follutein in 200 rat or mouse units may be employed until the bleeding is under control. Later it may be determined if a gland other than the pituitary is at fault. Eighty per cent of the authors' patients responded to this treatment, at least temporarily. Injections may be continued until the patient has had two normal menstrual periods if a pituitary deficiency is demonstrated or no endocrine diagnosis can be made. Patients who have been irregular in their flow prior to the onset of the abnormal bleeding usually require combined injections of the anterior pituitary extract and of placental hormone. Favorable results have been reported by the use of insulin in primary ovarian failure cases where the administration of the placental hormone with or without the pituitary extract is usually ineffective. Occasionally thyroid therapy is of value even though no hypo-thyroidism is demonstrated. Pituitary deficiencies require a high protein diet with supplemental vitamins. When the measures outlined fail, recourse to low-dosage roentgen irradiation of the pituitary and ovaries in the hypophyseal type and to the ovaries alone in the primary ovarian type, not only arrests hemorrhage in about half of the patients, but restores menstrual periodicity. The dose given at three weekly intervals is from 50 to 80 r. It has been employed in over 200 cases by the authors.—*W. R. Brooksher.*

Jonen, P. Zur Frage der Dauersterilisierung durch Radium. (Permanent sterilization with radium.) *Strahlentherapie*, 1933, *47*, 309–321.

Permanent sterilization with roentgen rays is brought about by complete destruction of ovarian function with secondary atrophy of the mucosa of the uterus. But on intrauterine use

of radium sterility is brought about by the immediate action of the rays on the endometrium though the irradiation extends far enough so that there is some injury of ovarian function also. Therefore, there are signs of the menopause after both methods of sterilization. It is impossible to prevent these with roentgen irradiation but they can to a very great degree be overcome on radium irradiation by the proper technique. The greatest intensity of the irradiation extends laterally from the preparation in the uterus, while the irradiation extending upward is much weaker. Therefore, if the uterus is caught and pulled down so that the ovaries lie at or above the fundus, they are only slightly affected by the irradiation. Ordinarily when radium is placed in the uterus the vagina is tamponed to hold the preparation in place, and in this way the uterus is pushed up so that the ovaries are brought into the zone of most intense irradiation. The author has used this method of bringing down the uterus and sparing the ovaries in 8 cases with good immediate results, but the time since treatment has only been eight months, so that the permanent results are not yet known.—*Audrey G. Morgan.*

Gál, Felix. Über einen durch Radium geheilten Fall von Chorioepitheliom der Vagina. (A case of chorionepithelioma of the vagina treated with radium.) *Strahlentherapie*, 1933, *47*, 322-325.

Surgery is still considered the treatment of choice in chorionepithelioma by many authorities. The operative mortality is high, however, and the author believes that radium irradiation is the treatment of choice, particularly in cases in the vagina that are readily accessible. In 1914 and 1915 two cases of vaginal chorioepithelioma were successfully treated with radium in his clinic, and he now describes a third case.

The patient was a woman of thirty-seven who came for treatment for tumors of the vagina which were obviously chorionepitheliomata. She was in very poor general condition, extremely weak and anemic, and with a temperature varying from 38.5° to 40° C., pulse 120 to 140. Any hemorrhage would have been extremely dangerous. Therefore 60 mg. radium was placed in the vagina and left for twenty-four hours. The results were astonishing. Her temperature fell during the treatment to 37° C., and did not rise again. The pulse fell to 100, and after a few days to 80. She was then given roentgen treatment over two abdominal and three sacral fields, a total dosage of 80 per cent of a skin erythema dose being given. Twelve days after the radium treatment all tumors of the vagina had disappeared, and there was nothing pathological except an ulceration of the mucous membrane the size of a penny at the site of the largest tumor on the posterior wall. This ulcer healed before she was discharged. Irradiation is to be preferred to surgery in these cases, particularly on account of the danger of hemorrhage and infection on surgical operation. There is also danger of disseminating the tumor and causing metastases by surgical procedure. This danger also is obviated by irradiation.—*Audrey G. Morgan.*

Kleine, H. O. Die Sonderstellung der Granulosakarzinome des Ovariums in klinischer, histologischer und strahlentherapeutischer Hinsicht. (The clinical, histological and radiotherapeutic peculiarities of granulosa carcinoma of the ovaries.) *Strahlentherapie*, 1933, *47*, 326–337.

Granulosa carcinomas are ovarian tumors which originate from the granulosa of the Graafian follicle. Tumors which originate from germinal epithelium are known to be very sensitive to the action of irradiation. Tumors which originate from the surface epithelium of the ovaries, however, are not nearly so sensitive as those originating from the granulosa epithelium, which is the true germinal epithelium. The term germinal epithelium should not be applied to the surface epithelium of the ovary, but only to the granulosa epithelium of the maturing follicle.

The author reports 12 cases of this form of carcinoma occurring in patients from three and a half to sixty-one years of age. These tumors have special endocrine actions. They stimulate the growth of the mammary glands, the myometrium, endometrium and the mucous membrane of the tubes. Glandular hyperplasia of the mucous membrane of the uterus is practically pathognomonic of granulosa carcinoma. This hyperplasia of the endometrium is even more characteristic than hemorrhage in the diagnosis of these tumors. The hemorrhage is caused by necrosis of the hyperplastic mucous membrane. In some cases there are also secreting glands, decidual transformation of the stroma cells, and production of glycogen in the glands and stroma of the endometrium. In one case in a woman of sixty-one there was a pro-

nounced heterotopic deep proliferation of the endometrium. This has also been described by other authors. The histological picture of the tubes is that of the sexually mature woman, even when the patients are children or old women, showing that the tubes as well as the endometrium are subject to the endocrine influence of the granulosa epithelium. In 5 of these cases the tumors were solid, while the other 7 contained cysts. The fluid of the cysts produced rut in animals and stimulated the growth of the mammary glands, showing that it contained follicle hormone. In 2 of the cases late metastases occurred, showing definitely that these tumors are carcinomatous. Late metastases seem to be characteristic of granulosa carcinoma.

The histological picture of the hypophysis did not show any characteristic changes in these cases. In sexually mature women the periods became normal after extirpation of the tumor. The radiosensitiveness of these tumors makes them especially adapted for radiotherapy. Careful histological examination should be made in each case as other ovarian tumors are much less sensitive to irradiation.—*Audrey G. Morgan.*

Gauss, C. J. Der gegenwärtige Stand der Röntgenstrahlenbehandlung der gutartigen Frauenleiden. (Roentgen treatment of benign gynecological diseases.) *Strahlentherapie*, 1933, *47*, 144–159.

The author gives a general review of the use of roentgen treatment in gynecological diseases, other than malignancy. In myoma, 34 to 45 per cent of a skin erythema dose is used to bring about permanent amenorrhea and disappearance of the tumors. Permanent amenorrhea and standstill of the growth of the tumor can be brought about in practically all of the cases. In about 86 per cent of the cases the tumor decreases in size, and in about 39 per cent it disappears completely. With present technique there are few contraindications to the roentgen treatment of myoma. It is contraindicated in pedunculated submucous myomas and in subserous myomas with a tendency to torsion of the pedicle, in which it is hard to make a differential diagnosis between myoma and tumor of the ovary. Of course, it is contraindicated if the patient is young and wants to have children. The signs of the menopause after roentgen irradiation are not particularly more severe than those of the natural menopause, but they are dependent to a certain extent on the psychic condition of the patient, and the treatment should not be given to very nervous or psychopathic patients. Some gynecologists still operate in a large proportion of cases of myoma, but in view of the fact that the primary operative mortality is 3 to 6 per cent while there is no mortality from irradiation, the author advocates extensive use of the latter method.

In the various hemorrhagic diseases of the uterus roentgen treatment is the method of choice when the patients have reached the age when sterility is not to be feared. Preliminary curettage should be performed in these cases in order to exclude possible carcinoma in the body of the uterus. Roentgen sterilization is indicated in cases in which pregnancy and labor are dangerous to the woman, as, for example, in severe pulmonary tuberculosis and heart lesions. It may also be used for eugenic indications in mental disease.

Temporary sterility can be brought about by 20 to 30 per cent of a skin erythema dose, but it is very difficult to determine dosage accurately, and in these cases there is always a possibility of injuring the offspring, so that some authors reject this method entirely. A stimulant irradiation with 4 to 15 per cent of a skin erythema dose has been used successfully in cases of insufficiency of the ovaries, and to hasten healing in inflammatory diseases of the adnexa. Roentgen irradiation has proved very successful in pruritus of the vulva given in a dosage of 30 per cent of a skin erythema dose with a filter of 1 to 4 mm. Al. It has also been used successfully in gonorrheal bartholinitis, eczema, acne, and furunculosis of the vulva, but the results are not so good in kraurosis of the vulva.

Because of the close interrelationship between the endocrine glands, irradiation of the hypophysis, thyroid, and thymus, has proved successful in many cases of hypermenorrhea, hypomenorrhea, amenorrhea, sterility, dysmenorrhea, dystrophy adiposogenitalis and acromegaly. Details are given in regard to the technique used by different authorities.

As it was found that irradiation of the spleen with 20 to 33 per cent of a skin erythema dose hastens coagulation this method was adopted for the treatment of genital hemorrhage. The doses used vary from 10 to 80 per cent of a skin erythema dose, with a filter of 0.5 mm. Zn. and 1 to 3 mm. Al. This method has proved

very successful in the control of hemorrhage. The results are generally very prompt, but sometimes only temporary, though they can generally be rendered permanent by repetition of the irradiation. Roentgen treatment has proved effective in various forms of mastitis.

Roentgen irradiation has given excellent results, both in nonspecific and tuberculous cystitis. It is also indicated in anuria, during pregnancy or labor. In some cases good results are obtained by general irradiation of the vegetative nervous system, as, for example, irradiation of the stomach region in hyperemesis gravidarium, irradiation of the salivary glands in the ptyalism of pregnancy and of the liver region in hyperfunction of the bile tract in pregnancy.

This brief review shows the wide field of use of radiotherapy in benign gynecological diseases.—*Audrey G. Morgan.*

Gál, Felix. Die Behandlung der Tuberkulose der weiblichen Genitalorgane. (Treatment of tuberculosis of female genital organs.) *Strahlentherapie*, 1933, *46*, 617–632.

About 80 to 90 per cent of all cases of tuberculosis of the female genitalia are tuberculosis of the tubes. The remaining cases affect the uterus, ovaries, portio, and frequently the peritoneum as well as the genitalia. The diagnosis of tuberculosis of the tubes is extremely difficult as its symptoms are practically the same as those of any other chronic inflammation of the adnexa. This, together with the fact that spontaneous recovery sometimes occurs, makes it difficult to decide on the treatment to be given. Exploratory laparotomy is very often necessary in making a diagnosis, so that surgical and radiotherapeutic methods are not competitors but supplement each other.

The author reports 53 cases treated at the University Gynecological Clinic in Budapest. Operation was performed in 42 of the cases and roentgen treatment was given in 13, in 11 of which the diagnosis had been made by exploratory laparotomy. Among the operated cases there were 2 deaths, 1 from ileus and 1 from thrombosis and embolism. The mortality given by various authors in operative cases ranges from 2 to 28 per cent. In all the other cases the results of operation were very good. Amenorrhea occurred in some cases, but these patients have a tendency to amenorrhea in any case and amenorrhea may follow any treatment. Operation was as conservative as possible. The ovaries were preserved in the majority of the cases. When very extensive tuberculosis is found on laparotomy radical operation should not be performed but the abdomen should be closed and roentgen therapy given.

In the roentgen cases the patients were irradiated three times a week with small doses. The abdomen was divided into four fields and each of them irradiated with 25 per cent of a skin erythema dose with 0.5 mm. zinc filter and 30 cm. focus-skin distance. There is no uniform tuberculosis dose but most authors recommend a relatively small dose. The results were excellent in all of these cases.

Three cases of tuberculosis of the portio are mentioned particularly, in which the ulcers looked so much like carcinoma that histological examination was necessary for diagnosis. There were no other foci of tuberculosis in these patients. One of these patients withdrew from the hospital before treatment, and recovered spontaneously. The two others recovered on the application of 60 mg. radium for twenty-four hours to the portio.

Many authorities now reject surgical treatment entirely in tuberculosis of the female genitalia. The author believes, however, that if the disease is limited to a single organ surgery is frequently indicated. Doubtless, however, with improved roentgen technique more and more cases will be given radiotherapy in order to avoid the mortality of surgical operation.

General ultraviolet irradiation is a valuable supplement to other methods of treatment, though it is doubtful whether it is sufficient in itself to cure tuberculosis. The good effect of roentgen rays is not due to destruction of the bacilli but to stimulation of the defensive forces of the body. Round cells and connective tissue are increased and the production of immune substances and phagocytosis stimulated. The broken down cells circulating in the blood may also have a general action like that of protein body therapy.—*Audrey G. Morgan.*

Dworzak, Hans. Zur Frage der Röntgentherapie der weiblichen Genitaltuberkulose. Histologische Nachuntersuchungen eines bestrahlten Falles. (Roentgen treatment of female genital tuberculosis. Histological examination of an irradiated case.) *Strahlentherapie*, 1933, *46*, 633-644.

Recently roentgen treatment has been substituted more and more for surgical treatment

of tuberculosis of the female genitalia doubtless because of the rather high postoperative mortality and frequent complications of the latter. In roentgen therapy small doses are used, ordinarily from 10 to 30 per cent of a skin erythema dose. This is lower than the castration dose so there is no permanent injury to the ovaries. Large fields are used covering practically the whole lower half of the abdomen.

The author reports a case of tuberculosis of the portio in a young woman of twenty-two. Histological examination of tissue from the portio showed tubercles, tubercle bacilli and giant cells. Palpation showed the adnexa normal and as there was no history of any other form of tuberculosis it was assumed that this was a case of primary tuberculosis of the uterus and portio. Irradiation was given over a small median field 6×8 cm. in size with the tubes and ovaries protected. There was improvement at first but after a time the changes seemed to remain stationary and reëxamination showed involvement of the adnexa. It was assumed that roentgen treatment had failed and the uterus and adnexa were removed surgically.

Histological examination of the specimen showed that the diagnosis of primary tuberculosis of the uterus had been a mistake. There were scattered tubercles on the peritoneum from which the process had evidently descended to the tubes, the body of the uterus and the portio. It showed, moreover, that the tuberculosis had been cured in the area that had been subjected to irradiation. There were only a few scattered tubercles on the portio and no tuberculosis of the body of the uterus. There was an abscess the size of a hazelnut in the body of the uterus filled with detritus but not a sign of tuberculosis. The active process was in the part of the genital tract that had not been irradiated and the boundary line between the tuberculous and non-tuberculous tissue was quite sharp, indicating that the effect was due to the irradiation.

It has been assumed that weak roentgen irradiation does not destroy tubercle bacilli, but that it produces their effect by an active immunization by ferments. This case is in contradiction with this theory. The effect of ferments could not have remained definitely limited to such a small area. The blood vessels of the uterus were very greatly dilated, and the author believes that the effects were largely due to the hyperemia resulting from this dilatation which was brought about by the irradiation. A similar effect is produced by exploratory laparotomy in tuberculosis of the peritoneum in which hyperemia of the peritoneum is a therapeutic factor. It is also possible that the rays break down tuberculous tissue directly as indicated by the abscess in this case.—*Audrey G. Morgan.*

Eymer, H. Ergebnisse der Strahlenbehandlung der Gebärmutterkrebse. (Results of radiotherapy of cancer of the uterus.) *Strahlentherapie*, 1933, *47*, 119–124.

The author reports the results of radiotherapy at the University Gynecological Clinic at Heidelberg for the years from 1913 to 1932. There were 587 cases of cancer of the cervix, and 115 of cancer of the body of the uterus, in which treatment had been completed for more than five years. Among the carcinomata of the cervix the absolute cure for the group of cases treated from 1913 to 1924 was 21.5 per cent. The relative cure in the operable cases 40.6 per cent, and the relative cure for the inoperable cases 10.5 per cent. For the group treated from 1925 to 1927, the corresponding figures were 25 per cent, 34.9 per cent, and 10.4 per cent. For the whole number of cases from 1913 to 1927, they were 22.3 per cent, 38.7 per cent, and 10.5 per cent. For the carcinomata of the body of the uterus the absolute cure for the group of 92 cases treated from 1913 to 1924 was 30.4 per cent. Relative cure in the operable cases 33.7 per cent, and in the inoperable cases 0, the mortality was 2.3 per cent. In the group of 23 cases treated from 1925 to 1927, the corresponding figures were 30.4 per cent, 35 per cent, 0 per cent, and 4.35 per cent. Among the total number of cases treated with radium, the mortality from 1913 to 1924 was 4 per cent and from 1925 to 1927, 2.3 per cent. During the former period there were 1.25 per cent injuries from irradiation while in the latter period there were none at all. These improvements are due to improvements in technique.—*Audrey G. Morgan.*

Jost, Dora. Untersuchung über die Indikation und den Erfolg der Schwachbestrahlung und temporären Kastration mit Röntgenstrahlen bei der Frau und ihre Bedeutung für die Nachkommenschaft, an Hand des Materials der Freiburger Universitäts-Frauenklinik. (The indications and results of weak irradiation and temporary castration with roentgen rays and its effect on the offspring, on the basis of the material of the Freiburg Uni-

versity Gynecological Clinic.) *Strahlentherapie*, 1933, *46*, 601–616.

The author makes a contribution to the question of whether weak or stimulant irradiation of the ovaries in women is injurious to their offspring. Among the 196 women whom they irradiated from 1919 to 1928 they had reports from 141. They were irradiated for amenorrhea, oligomenorrhea, dysmenorrhea, menorrhagia and metrorrhagia, inflammations of the adnexa and myoma.

Among these 141 women, 63 pregnancies occurred. Of these 48 ran to term, 14 ended in abortion and 1 in tubal abortion. Among the 14 abortions, 4 were to be attributed to the irradiation. There seems to be a certain tendency to abortion after roentgen irradiation. Among the 48 full term pregnancies 2 infants were born dead but there was no reason to attribute the stillbirths to the irradiation. Three of these deaths were not attributable to the irradiation. The other child died of celiac disease or Herter's disease, a severe insufficiency of the intestine or pancreas which was possibly caused by the irradiation.

The 43 living children, all except 1, were normal mentally and physically. This one child was born six months after a stimulant irradiation of the pregnant mother and was an obvious example of direct injury of the fetus by irradiation. It could not speak until it was three and a half years old, was considerably underdeveloped physically and suffered from strabismus and myopia.

On the basis of this one case of indirect injury, the author advises against irradiation of sexually active women, particularly as the results obtained by irradiation in the conditions in which it is used are not better than those obtained by less dangerous methods.—*Audrey G. Morgan.*

Freund, Leopold. Nach 36 Jahren. Späterscheinungen an mit Röntgen vorbestrahlten Hautstellen. (Late effects of roentgen irradiation after 36 years.) *Strahlentherapie*, 1933, *47*, 88–92.

The late findings are described in 3 cases which were irradiated thirty-two to thirty-six years ago. The first patient was irradiated in 1896, when she was five years old, for a pigmented nevus pilosus of the nape of the neck and lumbar region. Ten treatments of two hours each were given on the neck region, and forty-two hours of treatment within twenty-eight days in the lumbar region. An aluminun filter was used for the lumbar region. In the neck region there was a mild transitory dermatitis followed by falling out of the hair. In the lumbar region where the dosage was greater there was a general reaction with fever and albuminuria, extensive severe dermatitis, and a necrotic area in the center. After several months the necrotic central part was removed, and the wound covered with Thiersch flaps. The results of the operation were good. The wound healed with a contracted scar. The patient was well for thirty-three years, worked, married and had children. A few weeks ago an ulcer reappeared at the site of the old lumbar ulcer. Both the neck and lumbar regions were free of hair, but there was a deep ulcer in the discolored skin of the lumbar nevus. There were no signs of inflammation around it, and no swelling. Histological examination was not permitted and it is possible that the ulcer was malignant, as might seem to be indicated by the history and the fact that it developed on a pigmented nevus. The author thinks it probable, however, that the old scar had ruptured from excessive bending of the trunk and the ulcer resulted from poor vascularization in the scar tissue. Unfortunately, the patient withdrew from treatment and further observation was impossible.

The second patient was an elderly woman who was irradiated thirty-two years ago when she was a girl, for hypertrichosis of the chin and both cheeks, and the forearms. She was irradiated intermittently for several years with small divided doses of unfiltered rays, given with very hard tubes. She did not have any visible dermatitis during the whole time. She came at this time for treatment for her daughter, who also had hypertrichosis. Her chin and cheeks were completely free of hair, and the skin seemed absolutely normal. There was not a trace of atrophy, pigmented spots, telangiectases, or sclerosis. There were slight changes on the skin of the forearm. These cases show that roentgen rays have an excellent depilatory effect which is permanent, having lasted in these cases for three decades, and that this effect is not necessarily accompanied by any change in the skin. Now that measurement is more reliable than in those days, the results should be even better.

The third patient was irradiated in 1899, when he was a boy five years of age, for favus of the scalp. He is now a physician. He said that

he was not satisfied with the results of the treatment as the growth of his hair had been ruined. Most of his head was covered with coarse, brown, curly hair, but there were bald spots and other spots showing only a scanty growth of thin white hair. The author holds, however, that this was not the effect of the irradiation. These were spots where there had been foci of favus, which had exercised pressure on the papillae and injured or destroyed them. Papillae are not destroyed by roentgen rays unless the irradiation is very intense and causes severe dermatitis, or unless it is carried out for a long time. This was not true in this case. If the alopecia had been caused by the roentgen rays it would have been a large uniform area, and not in spots.

These cases are interesting as showing the late effects of roentgen irradiation.—*Audrey G. Morgan.*

Herold, K., and Meissner, Hans. Untersuchungen über den Urinfarbwert nach Röntgen- und Radiumbestrahlungen. (Study of pigment in the urine after roentgen and radium irradiation.) *Strahlentherapie*, 1933, *47*, 291–308.

There has been a great deal of discussion in regard to the effect of roentgen and radium irradiation on the red cells of the blood. The methods of studying the question in use heretofore have not proved satisfactory. The authors adopted a new method, that of studying the pigment in the urine after irradiation. Most of the pigments in the urine under both normal and pathological conditions are blood pigments. The method of determining the pigments is described in detail and curves are given showing the amount of pigment before and after irradiation in a number of cases of carcinoma.

After every irradiation there is more or less increase in the pigment excreted in the urine. After roentgen irradiation the amount of pigment generally lies only at the upper boundary of normal or slightly above it, while after radium irradiation the increase is much greater. In either case the increase lasts only for a short time. The extinction coefficients are normal, showing that the pigments are the same as those normally found in the urine. The only possible sources of this increased pigment are injury of the liver or blood pigment, and injury of the liver could be excluded in these cases. Therefore, the excess pigment must have been due to increased destruction of erythrocytes.

Though the amount of pigment is doubtless determined partly by dosage, there are other factors that enter into it. In cases with cachexia the resistance of the erythrocytes is decreased so that much larger amounts of pigment appear after irradiation than in less advanced cases. The increased pigment also persists for a much longer time. It may be possible by this method to determine in advance cases that are refractory to irradiation, evidence of this fact being furnished by the large amount of pigment excreted after the first irradiations. At any rate the determination of urinary pigment will be a valuable supplement to blood examination and may give even greater information in regard to the condition of a cancerous organism than these examinations.

According to the literature the amount of injury to the blood depends on the intensity of the irradiation, that is, the dose given in a unit of time. It is held that the blood is injured less on distant irradiation of long duration than with more intense dosage. This theory was not confirmed by the above examinations, for the injury was greater after less intense radium irradiation than after more intense roentgen irradiation. The authors believe that this may be due to the difference in wave length of the two forms of irradiation. Other electrical currents have a special affinity for certain cells, depending on their wave length. The gamma rays probably have greater affinity for erythrocytes than the longer wave roentgen rays.—*Audrey G. Morgan.*

Holfelder, H., and Reisner, A. Die therapeutische Beeinflussung der Polycythaemia rubra durch Röntgenstrahlen. (Treatment of polycythemia rubra with roentgen rays.) *Strahlentherapie*, 1933, *47*, 274–290.

Fifteen cases of polycythemia rubra treated with roentgen rays are described. Fourteen of these belonged to the Vaquez-Osler type, with enlargement of the spleen and normal or only slightly increased blood pressure, while one was of the Gaisböck type with high blood pressure and without enlargement of the spleen. In 4 cases the liver was enlarged.

Large fields 20×24 cm. over the long bones are irradiated in the following sequence: both legs, right thigh, left thigh, right humerus, left humerus. In addition to the long bones irradiation of the sternum is effective. The first case was treated with 6 to 8 individual doses of 30 to 50 per cent of skin erythema dose at inter-

vals of five to eight days. The results were not very good. Doses of at least 70 to 90 per cent of a skin erythema dose on the surface are necessary, with strong compression, and short intervals between the irradiation of the different bones. Small individual doses with long intervals lead to habituation. The total dose necessary for effective action is from 6,000 to 12,000 r given in four to seven weeks. The details of treatment are determined by the red blood picture. If, after temporary improvement, the blood picture and general condition grow worse again another series of treatment may be given. There is generally a free interval of one to two years between the series of treatments. This is long enough for the tissues to recover from the effects of the irradiation.

The number of white cells was also affected by the irradiation. The number of leucocytes may rise for a short time and then fall more or less rapidly, but normal values are reached again by the close of treatment or within two weeks afterward. If the number of white cells falls to 3,000, or if the fall is very rapid, it is advisable to be cautious in continuing treatment.

Improvement in the general condition runs parallel to the improvement in the blood picture, though the general condition often improves sooner than the blood count. No by-effects were seen except transitory increase in the pain in the limbs. Sgalitzer recommends general irradiation of the whole body, but the authors prefer to irradiate only the bones and protect the spleen with lead. They believe that irradiation of the bone marrow with large fields and large doses of hard rays is the method of choice in polycythemia. If the blood picture is properly followed up there is no danger of any njury.—*Audrey G. Morgan.*

Schwartz, Cerbu. Bursita degetului mare al piciorului. Roentgenterapie. Vindecare. (Bursitis of the big toe healed by roentgen therapy.) *Bul. Soc. de radiol. si electrol. med. din România*, April, 1933, *2*, No. 2, 9–11.

The author presents 3 cases of bursitis which developed on the basis of an incipient hallus valgus and which responded satisfactorily to roentgen therapy. The technique of irradiation was as follows: semihard rays obtained with 160 kv., 0.5 mm. Zn and 1 mm. Al as filters, 4 ma., 30 cm. distance, 500 r or 1/3 s.u.d. per seance; three ports of entry, one dorsal, one median and one solar, of 2.5×4.5 cm. each. The healing was complete and permanent.—*T. Leucutia.*

Wittenbeck, Franz. Neuere Ergebnisse mit der Röntgenbehandlung bei den Uteruskarzinomen. (Recent results in the roentgen treatment of carcinoma of the uterus.) *Strahlentherapie*, 1933, *47*, 631–635.

There has been a great deal of enthusiasm recently for Coutard's method of protracted fractional irradiation, and many of the articles in the literature give the impression that it is no longer possible to obtain satisfactory results with the old method of single irradiation. The author cites statistics to show that this is not true. Improvements have been made in the single dose method also in recent years. He divides his cases into two groups, one including those treated from 1916 up to 1922, and the other those treated from 1922 up to the end of March, 1928. Among operable cases of carcinoma of the cervix for the first period he had 50 per cent permanent cures and in the second group 68 per cent. Permanent cure means as usual that the patients were free of recurrence after five years or more. Among the inoperable cases of carcinoma of the cervix there were 11 per cent permanent cures in the first group, and 15 per cent in the second group. Among carcinomata of the body of the uterus, operable cases, there were 64 per cent permanent cures in the first group, and 76 per cent in the second. Among the inoperable cases 4 per cent in the first group, and 21 per cent in the second. These results compare favorably with those of the protracted fractional method.

The foundation of their method is the exact application of the dose which destroys carcinoma. This is 110 per cent of the skin erythema dose for pavement epithelial carcinoma of the portio, and 125 per cent of the skin erythema dose in adenocarcinoma of the cervix and body of the uterus. This higher dosage in adenocarcinoma is the secret of the excellent results in this form of tumor, which has been considered very radioresistant. These doses were applied by the Seitz-Wintz concentration method. The importance of preliminary treatment and after treatment is emphasized. The most important preliminary measure is disinfection of the infected tumor. As the after treatment must be left largely to the general practitioner, close cooperation between him and the roentgenologist is necessary. Radium was used also in some of these cases, but the

dosage was so small that the good results are to be attributed to the roentgen treatment.—*Audrey G. Morgan.*

Schinz, Hans R. Weitere Bemerkungen zur operativen and radiotherapeutischen Behandlung der Krebse. (Operative and radiotherapeutic treatment of cancer.) *Strahlentherapie*, 1933, *47*, 453–474.

The author replies to von Schubert's criticism of his work comparing the results of operative and radiotherapeutic treatment of cancer in Volume 46 of *Strahlentherapie*. Von Schubert accused him of manipulating statistics in such a way as to give results favorable to radiotherapy and unfavorable to surgery, and reproached him for ignoring Wertheim's statistics which show very good surgical results. The author replied with a detailed discussion of the statistics of Faure and Fermoselle-Bacardi and a comparison with those of Weibel-Wertheim showing that there was at least no intentional distortion of the statistics. He calls attention to the very great extent to which statistical results are dependent on statistical methods. He gives further statistical tables which he says show that radiotherapy in carcinoma of the cervix even in the operable stage gives as good results as surgery; as there is no operative mortality from radiotherapy it becomes really superior to surgery. Moreover, there are no contraindications such as old age, heart weakness, pulmonary tuberculosis, etc. In the great majority of skin carcinomata radiotherapy is the treatment of choice. A combination of electrosurgery and radiotherapy is of great value in many cases. In melanomata he advocates intensive roentgen therapy rather than the electrocoagulation recommended by Miescher. He does not recommend indiscriminate use of electrocoagulation for skin carcinomata. The indications for electrocoagulation should be studied just as carefully as those for radiotherapy. The cosmetic results are not as good. Radiotherapy is indicated in the great majority of skin cancers.—*Audrey G. Morgan.*

Voltz, Friedrich. Untersuchungen an durch Strahlen nicht geheilten Kollumkarzinomen. (Studies of carcinoma of the cervix not cured by irradiation.) *Strahlentherapie*, 1933, *47*, 475–484.

A study of unsuccessful cases is sometimes even more valuable than a study of successful cases in improving methods of treatment. The author studied the cases from the Radiotherapeutic Institute of the University Gynecological Clinic of Munich from the beginning of 1921 to the end of 1927, with a view to determining what factors influence the success or failure of radiotherapy. He limited his study to groups I and II, that is, the operable and borderline cases. These cases are particularly interesting because there is still an active discussion as to whether primary radiotherapy is justifiable in them, or whether they should be treated surgically at first and then irradiated.

During this period 352 women of groups I and II were sent to the Institute for radiotherapeutic treatment. Of this number, 135, or 38.3 per cent, were still living and in good health after five years, while 217, or 61.7 per cent, had died. The number that died in group I was 90, or 50.6 per cent, while in group II the deaths amounted to 127, or 73 per cent.

In studying the factors which caused this mortality the author found that age has a decided effect on the results of treatment. The youngest patient was twenty-six years of age. From that age up until fifty the mortality decreases, and then increases slightly above that age. Immature carcinomata are more radiosensitive than mature ones, and therefore the results are better the earlier treatment is begun. Dosage also depends on the degree of maturity of the tumors. Larger doses should be given in the older cases. The economic and social condition of the patient has an effect on the results of treatment as it is much more difficult to carry out complete treatment among the poorer classes, and besides their general condition suffers from their poverty. The results are dependent to a very great extent on the dosage and if less than a certain minimum dose is given treatment is useless. Other factors that probably affect the results of treatment are the histological type of tumor, and the constitutional peculiarities of the patient.

The author uses a combined radium and roentgen treatment for carcinoma of the cervix. One radium preparation is placed in the cervix, and another in the vagina just outside the portio. Two series of treatments are given with an interval of eight weeks between them. If it is impossible for any reason to apply the two radium preparations a higher roentgen dosage must be given in compensation.—*Audrey G. Morgan.*

Ward, George Gray. Carcinoma of the cervix uteri. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 434–436.

The author reports on 357 cases of carcinoma of the cervix, of which 23.8 per cent were well over five years. Of the early or operable cases (Stage I and II, Schmitz; Stage I, League of Nations) 52.2 per cent were well over five years and of the later or inoperable cases, 18.2 per cent were well over five years. There was a primary mortality of radium treatment of 1.1 per cent. Ninety-one per cent were of the epidermoid or squamous cell type. Contrary to the general belief that adenocarcinomata of the cervix are more difficult to cure than squamous cell carcinomata, the author obtained the best results in adenocarcinoma, 36.4 per cent. Of the squamous cell carcinomata Type II affords the best prognosis, Type I, the next, and Type III, the worst prognosis.—*J. H. Vastine.*

Warren, Shields. Studies on tumor metastasis. I. Distribution of metastases in carcinoma of the cervix uteri. *Surg., Gynec. & Obst.*, April, 1933, *56*, 742–745.

Histological grading is of but little value in estimating individual prognosis. It is of great value, however, in determining the radiosensitivity of the tumor and in determining whether or not the tumor is likely to metastasize. There is also close parallelism between the degree of malignancy and the total number of sites of metastasis of the tumors of a given grade. In tumors of the higher degrees of malignancy there is more widespread dissemination of the tumor, such unusual sites as the heart, spleen, kidney and thyroid being involved.

Of 25 cases of epidermoid carcinoma, group I, there were 10 cases, or 40 per cent, in which metastases were found at autopsy, in the following sites: regional nodes, 10 cases; distant nodes, 27 cases; liver, 1 case. Of 66 cases of epidermoid, grade II, carcinoma, there were 49 cases, or 74 per cent, in which metastases were found as follows: regional nodes, 46 cases; distant nodes, 31 cases; lungs, 8; liver, 15; bones, 3. There were 21 cases of epidermoid, grade III, carcinoma, in which metastases were found at autopsy, in 18, or 86 per cent, in about the same sites as in the grade II cases but with a proportionately greater percentage to lungs, liver and bones. There were metastases in 94 per cent of the adenoacanthoma and adenocarcinoma in the same sites.

Metastasis to bone is unusual in cervical carcinoma. In Warren's experience when metastasis to bone did occur it was always of the osteoclastic type.—*J. H. Vastine.*

Lynch, Frank W., and Bartlett, Edwin I. Cancer of the cervix and cancer of the breast; five year end-results in the University of California Hospital. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 424–426.

The authors report 20.3 per cent five year survival in 222 cases of cervical carcinoma treated by irradiation. In stages I and II, the early and borderline cases, there was a 58.8 per cent five year survival and in stages III and IV cases there was an 8.2 per cent five year survival.

In carcinoma of the breast there was a 78 per cent five year survival in 39 cases without axillary metastases and with favorable local conditions, such as small tumor or tumor in an outer quadrant. There was a 43 per cent five year survival in 14 cases without axillary metastases but with large primary tumors or tumors in an inner quadrant. There was a 26 per cent five year survival in 34 cases treated in which there were axillary metastases but favorable local conditions. In the 69 cases with axillary metastases and unfavorable local conditions there was a 7 per cent five year survival. The breast cases were treated surgically. The authors do not state whether the patients were irradiated occasionally or routinely.—*J. H. Vastine.*

Taylor, Howard C., Jr. Five year cures of gynecological cancer. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 422–423.

The author reports on 506 cases of malignancy of the female genital tract treated at the Roosevelt Hospital from 1910 to 1925. The cases treated during the forepart of this period greatly reduced the results. These have improved since the use of radium which was begun in 1917, and high voltage roentgen rays which was begun in 1924. For the entire period, including all cases, the absolute five year cures were as follows: cervix, 13 per cent; corpus, 24 per cent; ovary, 7.6 per cent; vulva, 23 per cent; vagina, 14 per cent. Counting untraced cases as failures, 1 patient in 7 was well five years later, in a group in which two-thirds were

advanced when they first came for treatment. Five year cures may be hoped for in over half of the early cases and in over one-third of the intermediate cases.—*J. H. Vastine.*

Keller, Fr. Klinische und experimentelle Beobachtungen zur Frage der fraktionierten Bestrahlung des Karzinoms. (Clinical and experimental study of fractional irradiation of carcinoma.) *Strahlentherapie*, 1933, *47*, 636–645.

The author describes experiments in the fractional irradiation of skin tumors in mice. On daily irradiation with one-third of a skin erythema dose two and a half times as large a dose could be given without producing the epilation produced by a single dose. There was a certain amount of decrease in the size of the tumors during fractional irradiation but after discontinuance of the treatment the tumors continued to increase in size, otherwise there was no effect on the tumors. Animals with large tumors bore the fractional irradiation very badly and metastasis occurred in a large number of the cases after discontinuance of the irradiation.

Attempts to use the fractional method clinically did not prove successful. Severe complications occurred much more frequently than with the old method.—*Audrey G. Morgan.*

Kirchhoff, Heinz, and Winckler, R. Über die protrahiertfraktionierte Röntgenbestrahlung beim weiblichen Genitalkarzinom. (Protracted fractional roentgen irradiation of carcinoma of the female genitalia.) *Strahlentherapie*, 1933, *47*, 601–626.

The authors report their experience with protracted fractional irradiation in 181 cases of carcinoma of the female genitalia. The five year period has not passed so these cases are not available for ordinary statistical purposes, but their object is to show the effect of fractioning and increased doses. While the results on the whole were poor, as many of the patients were in a very advanced stage of the disease, they were better in the cases treated with high dosage than in those treated with low dosage. For future treatment the authors recommend large individual doses at least in the beginning, a more rapid rhythm, and a high total dosage of at least 4,000 r at the focus. They do not recommend homogeneous irradiation of the pelvis with large fields on the abdomen or back but the best possible concentration on the focus through a small field. The dosage at the focus should be very accurately measured, preferably with a Hammer dosimeter in combination with a focussing apparatus devised by the authors themselves. Effort in the future should be devoted to the further development of this method.—*Audrey G. Morgan.*

Wintz, H. Vergleich der Dosen bei der protrahiert-fraktionierten und bei der einzeitigen Röntgenbestrahlung. (Comparison of doses in the protracted fractional and single treatment methods of roentgen irradiation.) *Strahlentherapie*, 1933, *48*, 535–551.

The author treated pavement epithelial carcinomata of the portio with a single dose method and with the protracted fractional method following exactly the technique used by the Radium Institute of Paris. The dosages were calculated by the two methods taking into account all factors which could affect the dosage at the surface and at the focus. They were also determined by measurements on a suitable phantom and a correlation established between the single irradiation method and the Coutard method. The proportionate dosage by the single irradiation method and the Coutard method was for the skin 1:2, for the carcinoma 1:2.4, for the intestine 1:2.2, and for the connective tissue 1:1.4. The dosage for the carcinoma by the Coutard method was so high that that in itself is sufficient to explain the destruction of the tumor. The results of irradiation by the Coutard method are not caused by increased radiosensitiveness of the tumor brought about by fractioning of the dosage as has been claimed by the advocates of the method. The single dose method is to be preferred to the protracted fractional method, both because of the results produced by smaller dosage and because the carcinoma cells remain more radiosensitive by this method. Partial habituation of the cells to the rays occurs with any method of fractioning, and if the individual doses are too small and the intervals too long the tumors may become refractory to the rays. This explains the failures reported by some authors with the method.—*Audrey G. Morgan.*

Schloss, Wilhelm, and Urbach, Franz. Zur Strahlentherapie des Peniskarzinoms. (Radiotherapy in carcinoma of the penis.) *Strahlentherapie*, 1933, *47*, 443–452.

There are no large collections of cases of carcinoma of the penis in the German literature,

only scattered reports of individual cases. Monod, in 1930, reported 19 cases from the Paris Radium Institute with 14 permanent results. The authors have treated 10 cases, either with radium therapy alone or with a combination of radium therapy and electrocoagulation. Six of these patients are at present free of symptoms, 2 for more than one year, 1 for six months, 1 for three months, and 2 cases were only treated six weeks ago. One case is improved, 2 cases not affected and in 1 very far advanced case the patient died. Five typical cases are described and illustrated with photographs.

Though carcinoma of the penis is quite radiosensitive the difficulty in treatment lies in the fact that the normal tissues of the penis are also very radiosensitive. Extremely careful radium dosage is therefore necessary. Another difficulty lies in the danger of infecting the tumor and the glands. The mobility of the penis also creates technical difficulties.

In the authors' cases that were treated by irradiation only, the patients had no difficulty in micturition and no operative procedure was necessary, but in 2 cases in which electrocoagulation was used the urethra became impermeable, and it was necessary to establish a suprapubic fistula.

It is difficult to determine dosage accurately on account of the curved surface of the penis. The authors describe their method of calculating dosage.

Carcinoma of the penis is generally thought to be very rare but this is true only when it is compared with the total number of carcinomata. Among skin carcinomata it occupies first place and is much more frequent than is generally believed. The cases generally come late for treatment because men hesitate to go to a physician for disease of the penis. Education of the public in this respect is necessary.—*Audrey G. Morgan.*

Schinz, H. R., and Senti, A. Krebssterblichkeit in Zurich. (Cancer mortality in Zurich.) *Strahlentherapie*, 1933, *48*, 51–72.

Tables are given showing the cancer statistics for Zurich from 1893 to 1931. The cases are classified according to types of tumor and according to age groups. Carcinoma is at present the most frequent cause of death in Zurich. About 400 persons a year die of cancer out of a total of approximately half a million inhabitants. The tables seem to show, however, that the increase in cancer mortality is not real, but apparent, due to the fact that people live longer than they formerly did, and therefore more individuals reach the higher age group where cancer is more prevalent. A large part of the increase shown in these tables is in the two higher age groups over seventy years of age. Some forms of cancer have even decreased in the age groups under seventy.—*Audrey G. Morgan.*

Keene, Floyd E., and Payne, Franklin L. The results of radium treatment in functional uterine bleeding. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 322–329.

The authors analyzed 423 cases of functional uterine bleeding of which 391 were treated by radium. In young women success is measured in terms of normal menstruation and preservation of the reproductive function, while in older women success is measured by the control of uterine bleeding, with either temporary or permanent amenorrhea and without too severe menopausal reactions. The absence of both intermenstrual pain and acquired dysmenorrhea is a characteristic feature of functional bleeding. When pain is associated with irregular bleeding, some organic pelvic lesion is usually present even though examination fails to reveal it, and operation is preferable to radium therapy.

In patients under thirty years of age suffering from functional uterine bleeding irradiation is far superior to hysterectomy. In this group, treated by relatively small doses of radium, 400–500 mg-hr., menstruation was restored to normal or nearly normal in 88 per cent, permanent amenorrhea developed in 6 per cent and severe menopausal symptoms in only 8 per cent.

After thirty years of age, there is an increased susceptibility to irradiation which gradually increases and reaches its height in patients who continue to menstruate after the age of fifty. In this group 200–300 mg-hr. controlled the bleeding in 80 per cent with no permanent amenorrhea and no severe menopausal symptoms. With doses of 800 to 1,200 mg-hr. permanent amenorrhea occurred in 56 per cent and severe menopausal symptoms in 47 per cent. The authors believe irradiation to be the method of choice in this group, employing a dosage of 300 mg-hr., and an increase of not more than 100 mg-hr. in case re-irradiation becomes necessary.

In patients forty to fifty years of age the authors recommend 400 mg-hr. as controlling

the bleeding in over 80 per cent attended by a minimum menopausal disturbance. In women near or over fifty, increased radium dosage or roentgen therapy can be used because the incidence of severe menopausal symptoms will more nearly approximate that of the uninduced menopause. The incidence of severe menopausal symptoms under normal conditions probably lies between 5 and 10 per cent. The authors do not mention filtration, distance nor the length of the container.There were 110 married women under forty who gave birth to 11 normal babies subsequent to treatment, and had 12 miscarriages.

There is a morbidity of 0.76 per cent following radium treatment and no mortality, as compared to a morbidity of 10 per cent and a mortality of 0.5 per cent following hysterectomy. Even with ovarian conservation severe menopausal symptoms will occur in about 7 per cent of the cases following hysterectomy.—*J. H. Vastine.*

Burman, Curtis F. Cancer of the cervix uteri, *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 427–429.

The author reports on 1,578 cases treated at the Howard A. Kelly Hospital, between 1911 and 1927. The principal method of treatment was by radium. Operable cases included all the stages except those presenting firm fixation to the pelvic wall and those with definite palpable glandular metastases. All were treated with radium alone or with radium and roentgen rays. There was a 54.73 per cent five year salvage in this group. Prophylactic cases are the same stage as above in which surgery and roentgen rays were employed. There was a 41.60 per cent five year salvage. Inoperable cases include those with fixation to the pelvic walls, extensive vaginal extension and usually with extensive local glandular involvement. There was an 11.35 per cent five year salvage in this group. Recurrent cases include those with recurrences which have followed the surgical removal of the uterus for cancer of the cervix. There was an 11.25 per cent five year salvage in this group.—*J. H. Vastine.*

Keyes, Edward L. Five year cures of cancer of the testis, prostate, and bladder. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 462–463.

Cases of malignancy of the testicle that are quite incurable by surgery because of their malignancy are the most radiosensitive. The author reports a case with large palpable abdominal metastases, treated by radium packs and orchidectomy, which was well six years later. The slow-growing, nodular cancers of the testicle are cured by surgery if discovered early enough. The wildly malignant seminoma requires both irradiation and surgery.

Cancer of the bladder presents a prognostic picture quite different from that of prostatic cancer. It gives symptoms relatively early, it is easily diagnosed, it usually attacks the base of the bladder whence dissemination is slow. Since 1925, with the exception of an occasional resection, the author has treated bladder cancers by implantation of gold or platinum seeds varying from 1.0 to 2.5 mc. of radium emanation. Forty-seven were treated in this manner of which 36 per cent have remained well five to ten years. There were 22 cases treated by other means with only a 10 per cent five year survival.—*J. H. Vastine.*

Keene, Floyd E. End-results of radium therapy in 475 cases of cervical cancer. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 416.

The author reports on 475 cases of carcinoma of the cervix treated from 1913 to 1926. Only advanced cases were treated with radium prior to 1920. From 1920 to 1926, both early and late cases were treated by irradiation.

In this latter period, there was an 18.28 per cent five year salvage. There was a 32.60 per cent five year salvage in cases classified as in stages 1 and 2, a 39. 65 per cent salvage in stage 1 cases treated by both cautery amputation and radium.

In cases graded according to the classification of Martzloff there was a 13.05 per cent curability in spindle cell carcinoma, a 26.66 per cent curability in transitional cell carcinoma and a 17.85 per cent curability in adenocarcinoma.

During the past year their treatment has been greatly modified both by improving the radium technique and by including roentgen therapy routinely.—*J. H. Vastine.*

Davis, Lincoln. Results of treatment of cancer of the uterus at the Massachusetts General Hospital. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 430–432.

The author reports on 157 cases of carcinoma of the uterus. In carcinoma of the cervix, there were 43 cases treated surgically by hysterectomy with a 37 per cent five year survival

There were 64 cases treated by irradiation with a 17 per cent five year survival. In this latter group, there was no selection of cases; only the moribund were excluded. In carcinoma of the body of the uterus there were 50 cases treated surgically, with a 60 per cent five year survival. The author states, in regard to the use of radium in cervical carcinoma, that the results have been distinctly heartening, encouraging them to continue and extend its use with essential abandonment of hysterectomy. —*J. H. Vastine.*

Crile, George. End-results of the treatment of malignant disease at the Cleveland Clinic. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 417.

The author saw 8,679 cases of malignancy at the Cleveland Clinic, of which 4,059 seen prior to 1928, have been traced. The following table gives their results.

Location	*No. of Cases Treated*	*3 Year Survival*	*5 Year Survival*
Skin	215	100	52
Mouth	300	94	53
Larynx	106	14	9
Thyroid	185	55	37
Breast	919	437	307
Esophagus	140		
Stomach	726	13	7
Large bowel	466	89	48
Kidney	143	16	7
Bladder	288	47	30
Prostate	212	24	9
Uterus	722	159	98
Bone	131	15	10

The above cases include those treated by operation alone, operation plus irradiation and irradiation alone. No record is given of the patients who died of intercurrent disease.—*J. H. Vastine.*

Moore, Sherwood. Irradiation in a case of osteogenic sarcoma; recovery. *Surg., Gynec. & Obst.*, March, 1933, *56*, 681–686.

The author reports a case of osteogenic sarcoma treated by radium interstitially and roentgen rays over ten years ago, with recovery. Tumor exploration and biopsy were done in this case without disseminating the tumor. Intratumoral radium implantation was employed in this case with success.

The author emphasizes the point that the case here reported was an early case, as contrasted to the advanced, unpromising cases usually referred to the radiologist for treatment.—*J. H. Vastine.*

Friedman, M. Treatment of bone tumors. *J. Med. Soc. N. Jersey*, March, 1933, *30*, 214–221.

Endothelial myeloma, multiple myeloma, giant cell tumor and chrondoblastic osteogenic sarcoma are the four primary radiosensitive bone tumors in the order of their sensitivity. This is a helpful fact for aid in diagnosis by therapeutic test. Radiation therapy should be discontinued in favor of surgery if definite results are not obtained in six weeks. Malignant bone tumors are curable under adequate therapy and the more highly differentiated the tumor, the higher will be the percentage of five year cures. Giant cell tumors are best treated by irradiation and failure of the method after six weeks should also suggest surgery. Multiple myeloma, endothelial myeloma, giant cell tumor, chondroma and osteogenic sarcoma are discussed with illustrative case records.—*W. R. Brooksher.*

Wilhelmy, E., and Ning Yü. Zur Frage des Leukozytensturzes nach Bestrahlungen mit sehr welchen Röntgenstrahlen. (Decrease of leucocytes after irradiation with very soft roentgen rays.) *Strahlentherapie*, 1933, *47*, 531–539.

There are still differences of opinion as to whether there is a fall in the number of leucocytes after irradiation with very soft roentgen rays. The majority of authors have confirmed Bucky's findings that a few minutes after irradiation with so-called Grenz rays there is a fall of more than 30 per cent in the number of leucocytes which is compensated for within half an hour to a few hours and may be followed by leucocytosis. Unfortunately, the number of cases studied by most of the authors was very few.

The authors carried out experiments on 38 normal male individuals. The experiments were made in the morning before breakfast and with the subjects at rest. Blood counts were made immediately before the irradiations and at intervals of five minutes afterwards. Half of the subjects were irradiated and half of them used as controls. Fields 6×6 cm. in size on the forearm were irradiated, with 0.02 mm. aluminum half-value layer, and 6 kv. According to Bucky, the minimum dose necessary to bring about a fall of leucocytes is 1/20 of a skin erythema dose, with a field 1 sq. cm. in area, 6 kv., and an irradiation time of at most a quarter of a minute. The authors used a dose

of 300 r. The minimum dose required to produce early erythema on the forearm is 120 to 150 r. With this dosage there was no change in the leucocyte count in the irradiated cases that differed from that in the non-irradiated cases. The variations in all the cases lay within a limit of 10 per cent. Tables and graphs are given showing the details of the results.

This, of course, does not prove that there might not be a fall of leucocytes in individuals suffering with certain diseases, or if much larger doses were used or rays of a different degree of hardness.—*Audrey G. Morgan.*

MISCELLANEOUS

PUGNO-VANONI, E., and REIMANN, C. Ein automatischer Spannungsregler zum Konstanthalten der elektrischen Betriebsbedingungen von Röntgenapparaten. (An automatic voltage regulator.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *47*, 707–715.

The application of stabilizers to diagnostic and therapeutic apparatus is first discussed and then the authors describe the stabilizer they have developed. It is rugged and sturdy and has no moving parts. It requires little attention and is not likely to get out of order.—*E. T. Leddy.*

CHANTRAINE, H., and PROFITLICH, P. Über die Bedeutung von Schärfe und Kontrast für die Mindestdicke von erkennbaren Einzelheiten. (The importance of sharpness and contrast in relation to the minimal thickness for observing detail.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *47*, 437–447.

Contrast and sharpness were investigated by roentgenographing lead letters, the first by changing the time of exposure and the latter by varying the distance between the letters and the film. With a uniform background and complete sharpness, only slight contrast is obtainable. In a detailed background variations can be seen even when there is good sharpness only when great contrast is present, while with increasing lack of sharpness the increase of contrast is relatively slow. The appreciation of detail requires with a background of large detail a 7½ times greater decrease of intensity in spite of good sharpness of detail. Tables show the minimal value which contrasts must have in order that details may be appreciated. Without scattered radiation at 110 kv. maximum, a layer twice as thick as with 38 kv. maximum is needed to produce an equal contrast. If it is, a layer four times as thick is needed. With 200 kv. without scattering a layer 2 times as thick, with scattering 5 times. With 110 kv. the contrast is about halved; by a voltage of 200 kv. it is decreased a third. The greater sharpness at higher voltages cannot offset the loss of contrast, since then thin details become visible. An increase of contrast improves detail only when there is a background which is of moderate intensity; if it is too contrasty a decrease in contrast makes appreciation of detail impossible.—*E. T. Leddy.*

WITTE, E. Welche Mittel gibt es, um bei diagnostischer Verwendung der Röntgenstrahlen die Dosis zu vermindern? (The methods of decreasing the dose in diagnostic procedures.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *47*, 312–322.

The author presents data to show the effect of increasing the distance in diagnostic exposures both in regard to the skin dose and the depth dose. Increasing filtration is detrimental to film quality only when the exposure is made through thin layers of tissue. The effect of filtration on the depth and surface doses is also discussed. He shows that 1 mm. aluminum in the cassettes hardens the radiation and he therefore advises that cassettes be as transparent as possible. He advises a special filter which permits rapid change from 0.5 mm. aluminum to 3 mm. aluminum when highly sensitive films are used. This filter protects the patient, saves wear on the tube and increases the efficiency of small apertures. He discusses next the effect of examination through a loupe in regard to the roentgen intensities required for satisfactory vision. He calculates that in extreme cases, that is, in particularly favorable conditions, on the one hand, and especially poor ones, on the other, such as occur in practice, a difference in the skin doses in the ratio 1:8.8 is likely.—*E. T. Leddy.*

DEMETROVIC, B., and ALBERTI, W. Über den Einfluss der Totalreflexion auf die Bildgebung bei Röntgenaufnahmen in Beziehung zum Machschen Effekt. (The effect of the total reflexion of roentgen rays on the production of roentgenograms with reference to the Mach effect.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *47*, 718–722.

By means of the Seemann spectrograph it can be shown that roentgen rays are strongly and regularly reflected even by bad reflectors within

the region of total reflexion. The existence of dark streaks between the semi-shadow and the geometrical shadow is demonstrated and explained on the basis of total reflexion. Attention is called to the fact that the Mach effect is to be regarded from a quantitative aspect as a slight nick in the intensity curve does not in all cases give rise to a Mach line. It is also pointed out that the Wind cover experiment is not a method free of objection in regard to deciding the subjectivity or objectivity of weak or thin lines as by the method undoubted objective weak lines are made to disappear.—*E. T. Leddy.*

Bouwers, A. Verkürzung der Aufnahmezeit durch eine neue Belastungsmethode. (Decreasing exposure time by a new method of loading the roentgen tube.) *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *47*, 703–706.

The target of a roentgen tube when submitted to constant bombardment soon reaches its limit of temperature. At the start of the load the temperature may be higher and the load greater than after a period of operation. The method described by Bouwers uses an initially increased and then reduced load whereby the limiting temperature of the focal spot is reached in about 0.01 second. It is demonstrated that by means of the new method a decrease of about 40 per cent in exposure time is possible. This method permits automatic loading to the highest possible point. The relationships of temperature and load are shown in charts illustrating various phases of the loading method.—*E. T. Leddy.*

Zwerg, H. G. Experimentelle Tumoren und ihre Bedeutung für die Erforschung der Röntgenstrahlenwirkung mit einem Beitrag zur Allgemeinwirkung der Röntgen- und Radiumstrahlen. (The importance of experimental tumors in studying the action of roentgen rays, and a study of the general action of roentgen and radium rays.) *Strahlentherapie*, 1933, *47*, 485–502.

Experiments are described in which rats were irradiated with varying doses of roentgen and radium rays in an effort to determine the effect of dosage on the growth of transplanted Jensen sarcoma. When the animals were irradiated on the back or abdomen with doses that caused such severe general injury that they barely lived, the inoculated sarcomata grew very rapidly to a size ten times that of the tumors in the control animals. The animals also died much more quickly of metastases and there were no spontaneous recoveries such as are sometimes seen in non-irradiated animals. The dosage which produced these effects was 300 to 360 r, measured on the surface: 180 kv., 4 ma., 23 cm. focus-skin distance, 0.3 mm. copper and 1 mm. aluminum filter, half-value layer 0.2 copper and 3 mm. aluminum. Doses up to 90 to 120 r did not break down the resistance of the animal to such an extent that this rapid growth took place and there was no marked difference between the growth of the tumors in the irradiated and the non-irradiated animals. Doses of more than 360 r killed the animals.

This general effect of the irradiation was very marked in inoculations made up to fourteen days after the irradiation; when inoculations were made later than that the effect was much less marked. It was found that the general injury was much less pronounced when the irradiation was prolonged and given in smaller doses per minute. This is in harmony with clinical experience with protracted refractional irradiation.—*Audrey G. Morgan.*

Davis, Loyal, and Cutler, Max. An experimental and clinical study of the use of radium in the brain. *Surg., Gynec. & Obst.*, Feb. 15, 1933, *56*, 280–293.

The authors introduced radium needles interstitially in the parietal area of the cerebral hemisphere, or the cerebellar hemisphere in experimental animals. The radium was contained in iridioplatinum needles with 0.5 mm. walls, 2.2 cm. in length, each needle containing 1.0 mg. of radium element—the needles were introduced 1.0 cm. apart and left in place for as long as 216 hours, four such needles thus giving 864 mg-hr. of irradiation. The pathological changes which followed the insertion of the radium gradually faded away to the normal within the radius of a centimeter from the central zone of destruction. Radium needles were used in one human—a fourteen-year-old boy with an advanced glioblastoma. There was temporary improvement but the child died two months later, and no autopsy was obtained. Eight 2 mg. radium needles were implanted into the tumor mass at intervals of about 1 cm, 2,688 mg-hr. of radium being given. There was no postoperative rise in intracranial tension as a result of the radium. It is important to provide adequate decompression to provide for any possible rise in intracranial tension.—*J. H. Vastine.*

THORAEUS, R. Tin-filters in roentgen therapy. *Acta radiol.*, 1934, *15*, 225–236.

After a detailed discussion of the filtering properties of different materials based on a study of monochromatic absorption the author early in 1928 devised a new compound filter, the chief part of which was a tin plate. The properties of this filter with reference to average transparency and the quality of the filtered rays were measured by means of the standard air ionization chamber and compared with the properties of different copper filters. It was found that the tin filters give much greater economy of infiltration than copper filters that are equivalent qualitatively.

Measurements were made of the ionometric intensity at the surface of a phantom and inside of it, and the amount of secondary radiation determined. It was found that the percentage of secondary radiation to total radiation within the range studied was practically independent of both filter and tube voltage. The amount of secondary radiation, however, is very greatly affected by the size of the field irradiated.

A table is given showing the percentage depth doses obtained with the normal tin filter.—*Audrey G. Morgan.*

SIEVERT, ROLF M., and BENNER, SVEN. On a method for control of radium preparations, used at Radiumhemmet. *Acta radiol.*, 1934, *15*, 309–314.

The new methods based on the condenser chamber principle of Sievert which are used at the Radiumhemmet physical laboratory for control of radium preparations are described. This control is carried out partly by an individual measurement of the preparations and partly by an annual group control measurement of a certain number of preparations. A possible source of error in the group control measurement is that the sensitivity of the chambers may change in the course of time. Methods of detecting such changes are described.—*Audrey G. Morgan.*

BENNER, SVEN. The intensity distribution around radium preparations. *Acta radiol.*, 1934, *15*, 291–303.

Different methods of measuring and calculating the distribution of intensity around radium preparations are discussed. Measurements were made by the author on phantoms and patients, using Sievert's condenser chamber method. As a rule, the distribution of intensity observed agreed with that calculated theoretically, but the absolute values were too high. The causes of this divergence are discussed. If the chambers are calibrated in water the experimental results in water agree with the calculated values within about 10 per cent. The thin-walled chambers used by the author are not suitable, however, for measuring the distribution of intensity in the air.—*Audrey G. Morgan.*

SIEVERT, ROLF M. Über die Anwendung der Kondensatorkammer für sowohl Röntgen- wie γ-Strahlenmessungen; zugleich ein Beitrag zu den Vergleichen der biologischen Wirkungen dieser beiden Strahlenarten. (The use of a condenser chamber for measurement of both roentgen and gamma rays, together with a comparison of the biological actions of these two kinds of rays.) *Acta radiol.*, 1934, *15*, 193–201.

In 1926 the author introduced a new method, the so-called condenser method, for the measurement of roentgen rays. He has developed this condenser chamber method further so that chambers can now be produced which give values that are independent of wave length, and which can be used both in roentgen and radium therapy. A chamber of this kind is described. Its capacity is large enough so that doses of irradiation of several hundred r can be measured directly on the patient during treatment. The author also compares the correlation numbers of Imc-hours (milligram-element-hour at a distance of 1 cm.) and r observed by several investigators, and shows that the values based on biological observations, skin erythema, for instance, are considerably lower than the calculated values. Apparently, therefore, it requires a larger dosage of hard rays in r to produce skin erythema than it does of soft rays.—*Audrey G. Morgan.*

BOUWERS, A. Eine Röntgenröhre mit drehbarer Anode und "Anodenkühlung." (A roentgen-ray tube with a rotating anode and "anode cooling.") *Fortschr. a. d. Geb. d. Röntgenstrahlen*, 1933, *48*, 232–233.

A tube with a rotating anode (Rotalix tube) is described which allows the making of a practically unlimited number of exposures or screen examinations per hour. The principle of "anode cooling" is based on heat radiation from an artificially blackened and greatly enlarged anode to a similarly blackened and enlarged cooling surface. In this way the energy used in diagnosis is easily taken care of.—*E. T. Leddy.*